THE

LABORATORY;

OR,

SCHOOL OF ARTS:

CONTAINING

A LARGE COLLECTION OF VALUABLE

SECRETS, EXPERIMENTS, AND MANUAL OPERATIONS

IN

ARTS AND MANUFACTURES,

HIGHLY USEFUL TO

GILDERS,
JEWELLERS,
ENAMELLERS,
GOLDSMITHS,
DYERS,
CUTLERS,
PEWTERERS,
JOINERS,
JAPANNERS,
BOOK-BINDERS,
PLASTERERS,
ARTISTS,

AND TO THE WORKERS IN METALS IN GENERAL;

AND IN

PLASTER OF PARIS, WOOD, IVORY, BONE, HORN, AND OTHER MATERIALS

COMPILED ORIGINALLY BY

G. SMITH.

Sixth Edition,

WITH A GREAT NUMBER OF ADDITIONAL RECEIPTS, CORRECTIONS, AND AMENDMENTS,
A COMPLETE TREATISE ON FIRE-WORKS, AND THE ART OF SHORT-HAND WRITING.
ILLUSTRATED WITH ENGRAVINGS.

VOL. I.

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PREFACE

TO

THE SIXTH EDITION.

THE arts have so necessary a dependance on each other, that it would be an useless task to endeavour to point out their advantage to mankind. Daily experience, and indeed the mere operation of our senses, confirm the impossibility of detailing the utility which must result from the publication of human inventions. The rapid progress of the physical sciences has been the occasion of much labour to the learned, whose works have been often rendered useless by the appearance of new volumes, and has given rise to many compilations and abridgments. But for these compressions of matter into reasonable bounds, in the forms of Dictionaries and Encyclopædias, the diffusion of knowledge would be less extensive; because the price would be too high for the generality of readers, and discoveries would chance to remain scattered and uncollected.

But whilst the succession of every year may have thrown a light upon the principles of many facts which were before unknown to us, we should take heed that many of the facts themselves do not escape us. The history of former ages has furnished the woful certainty of the loss of many arts, which the unwearied attention of succeeding times may be long in restoring. Had the simple manual of every art been recorded, without attempting to bewilder by the addition of theory, we should probably be in the possession of what we may wistfully require in vain. Of these valuable secrets which have been lost, the one of rendering *glass malleable*, is alone sufficient to claim our sorrow.

The original plan and intention of the work which is now announced to the Public, was to disseminate, in a reasonable way, what had been collected at great cost and expence; such as the secret methods of working which were practised by artists in their several employments, and various other valuable receipts.—With the same view, this new edition appears, which is no fewer than *the sixth* from its first publication.

Why a work of so distant a date is still held in such great request, is owing to the reasons assigned above, that *it is a repository of many operations which are employed at this very time*, free from theoretical descriptions, and therefore intelligible to the meanest capacity.—Moreover, the terms of art, and the names of the several ingredients, are conformable to those in *common use*, and such as on enquiry at druggists shops will be known and sold under those titles.

A work of this kind is ever useful, although it be not adapted to the reading of philosophical students; for unless some such publications are afloat, philosophers themselves, in distant periods, would be deprived of the very materials of their own labours: it is by the established custom of tradesmen following the occupation of their fathers, that the manual arts have been preserved in the East.

Many of the passages in this edition will be found entirely expunged, by comparing it with former ones: many of them are abridged; most of them are corrected; and a variety of new matter is added. Sometimes whole paragraphs, and even chapters, have been transposed; which has been purposely done, to arrange it in a series more orderly and convenient.

venient. The chapter on Fire-works, for instance, here begins the work, because it forms one of the earliest amusements of youth, and will be likely to employ their first attention to experiment; thence, gradually acquiring a manual expertness, they will be led to undertake more elaborate operations, and be initiated in a fondness for philosophy. For the retention of some peculiarities, such as *the usual and ordinary appellations of drugs and chemicals*, in lieu of modern philosophical names, a fair reason has been assigned; and, indeed, to employ new terms would totally defeat the intention of the work, which is compiled for a valuable class of men, whose operations must be couched in their own technical terms. *Quickening* is a singular expression to be employed in gilding, but water-gilders are accustomed to the phrase, and employ it constantly. *Black-lead pencils* are also known to every class of society, independent of artists who are more acquainted with their use; yet it is a notorious fact that they have not a particle of lead in their composition.* Some terms, then, cannot be corrected, unless a display of knowledge be preferred to the more valuable requisite of being intelligible.

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* What was supposed, by the old chemists, to be *black-lead*, is now well-known to be a compound of *iron*; called *carbure of iron*, in modern chemical language.

It must be confessed, indeed, that a number of the receipts might be greatly amended, and the processes of many of them be curtailed and cheapened; but it has been thought better to retain all, except such as are impracticable at the first glance, and to make additions to the original stock; for this reason, that many of them are still in request by workmen, whose time is principally busied *in effects*, and are little observant and anxious of the causes of such effects. Till, therefore, some able chemist, whose time is at his command, will condescend to leave the chase after new discoveries, and give the condensed hiſtory, the rationale, and improved manual of the operative arts, we muſt be content to offer such as is known, and add occasionally (as will be found in this Edition) fresh receipts as fresh matter is produced. By the addition of new processes, in lieu of entirely expunging the old, another advantage will accrue—that the methods of working formerly known, will still be in preservation, whereby a basis is left for improvement, by the ingenious, as the theory of the arts is gradually unfolding. The just and obvious objection to obsolete experiments is, therefore, in some measure removed; and it is hoped, that the large class of young people, whom these recreations concern, may find the amusement and instruction which it is so much their interest to cultivate.

Before a final close is put to the above observations, it may be proper to remark, that a useful treatise has been introduced, in this edition, on the practice of *Short-hand writing.* When a quick and easy mode of committing either our own thoughts, or those of others, to the safe-guard of manuscript, is attainable, no one surely will forego the application of a few hours to the occasional practice of the art! A thousand thoughts which daily strike us may be thus instantly preserved from destruction, to the future benefit of ourselves, and the probable benefit of posterity: and if our ideas be, at first, crude and undigested, which will be too frequently the case in sudden flights of imagination, they will be recorded in symbols of more than ordinary usage, of course, free from observation till matured by time.

The few explanatory notes, marked *Ed.* are by the Editor.

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THE LABORATORY:

OR,

SCHOOL OF ARTS.

PART I.

ARTIFICIAL FIRE-WORKS.

AS the principal ingredient in Artificial Fire-works is compounded of three substances, of the nature of which the reader may not be acquainted, we shall set out with giving a short account of gunpowder, and its component parts—Nitre, Sulphur, and Charcoal.

Gunpowder is so well known by its effects, as to render it unnecessary to give any particular description, further than to state, that it is an intimate mixture of seventy-five parts of purified nitre, nine and a half parts of sulphur, and fifteen and a half parts of charcoal. Many other proportions have been employed, but the above are found to succeed, for general uses, the best of any other; because its force and goodness greatly depends on the total decomposition of the nitre, and the rapidity with which it is performed. The accuracy and intimacy of the mixture must of course be as great a requisite as the very ingredients themselves; and the combination is attended with no small degree of danger. In large manufactories, a mill is employed, in which wooden mortars are disposed in rows, and in each of which is a wooden pestle, moved by the arbor of a wheel turned by water, or wind. The materials are pounded and mixed in these wooden mortars, for twelve hours together, being occasionally moistened during the trituration, to prevent any sudden explosion. Nothing now remains, after the above operation, but to form the powder into grains, which is found wonderfully to improve its powers, and renders it less liable to soil the fingers, or foul the barrels of fire-arms:—the grains are made larger for cannon, and smaller for muskets. No process can be well imagined more simple than the granulation of the powder. It is placed to a certain thickness upon sieves, the holes of which are of a certain diameter, and a flat piece of wood is horizontally pressed upon the surface of the powder. The powder being damp when taken from the mill, for the reasons stated above, is readily formed into molecules of the size of the holes, and its surface rendered smoother, less liable to adhere to the surfaces of other bodies, and admitting a freer contact of atmospherical air between its particles. A still greater smoothness, and even lustre, is given to it, by putting a portion into a barrel, which turns upon an axis, by means of wheel-work, and produces a certain degree of friction. After this, the whole grains are separated from the finer powder, by sifting it; and the finer powder is again granulated, and finished like the rest.—We now proceed to treat briefly of the several ingredients: and first of

NITRE.

Nitre, or common saltpetre, is formed by the union of the nitric acid with potash. This salt is of a fresh taste and its crystals are, uniformly, six-sided prisms, terminating in dihedral pyramids, or cut off with a slope, and channelled, frequently, from one end to the other. There is great abundance of this salt in nature, as it is continually forming in places frequented by animals, and on walls secured from rain, and in the rubbish and plaster of old buildings.

Three circumstances seem to be necessary to the formation of nitre. First, calcareous earth, which forms a nidus for its reception in buildings, &c.: Secondly, animal substances; for it is a known fact, that places watered by animal liquors, and in a state of putrefaction, such as dunghills, stables, jakes, &c. afford great quantities of nitre: Thirdly, the contact of air, without which no nitre could be formed. Upon the above principles are founded the beds of artificial nitre-works. To this effect, a number of proposals have been made, from time to time, by ingenious men, whereby vast quantities of nitre might certainly be formed, to the great advantage of the state, and emolument of the speculator. But this has been little attended to in England, which is supplied from her settlements in the East-Indies, with more than perhaps she can consume. Spain alone could furnish all Europe with this commodity, according to the information of Mr. Townsend; but she keeps it principally for her own use, and that of her colonies. France also manufactures this article in great abundance, of as excellent and pure a quality as any on the globe. When nitre has been dissolved, and freed of its impurities, and re-crystallized, it is fitted for the making of gunpowder.

OF SULPHUR, OR BRIMSTONE.

SULPHUR, or brimstone, is a combustible body; dry, brittle, of a citron yellow colour, without smell, except when burnt; of a peculiar taste, which is weak though perceptible. It is electric when rubbed, and crackles and breaks on being instantly exposed to heat. Sulphur is combined with a number of substances, and pervades all nature; but we shall here only speak of it pure and uncombined. It is usually obtained by the decomposition of a mineral substance termed *pyrites*. In Saxony and Bohemia, it is manufactured in a more elaborate manner than elsewhere; it is put in earthen tubes, in small pieces, and placed on an oblong furnace. One end of the tube stands in the furnace, and the other passes into a vessel of cast-iron, containing water. In this receiver the sulphur accumulates, though impure; and it is afterwards purified by melting it in an iron ladle, which causes the impurities to be precipitated to the bottom. It is again kept in fusion in a copper boiler, and it is then poured into wooden cylindrical moulds, which give it the form in which we usually see it in commerce.

CHARCOAL.

CHARCOAL is the black residue of vegetable matter, whose volatile principles have been decomposed and set at liberty by fire. Different vegetable matters afford coal in greater or less abundance, according to the solidity and form of their texture. It has a strong attraction for all substances which contain *vital* or *pure* air, (now termed *oxygene*) which is one reason for the phenomena we see in the explosion of gunpowder. The charcoal of willow-wood is preferred, by many, for the manufacture of gunpowder; though others maintain, that the coal of hard woods is equally fitted for the purpose, provided it be thoroughly burned, and preserved from the contact of the atmosphere during the operation.

Having now mentioned, in a cursory way, the nature of gunpowder, and its several parts, it remains only that we detail a few other ingredients, and processes, employed in the composition of fire-works, previous to describing the fire-works themselves.

How to break or granulate Sulphur.

TAKE some spirits; put a handful of sulphur therein, and let it dissolve; then take a broad stick, and stir it about till it grows mealy, and like sand. If you would again have it strong and hard, fling a little nitre into it.

To combine Oil with Sulphur.

FILL a matrass with fine pulverised sulphur, about one-third full; on this pour as much nut or elder oil as will fill the matrass half full; set it in warm ashes, and let it stand for eight or nine hours, and the oil will change the sulphur to a high red colour.

To make artificial Camphor, and its Oil.

TAKE of pulverised juniper-gum two pounds, and of distilled vinegar enough to cover it; close them together in a glass phial; set it for twenty days in warm horse dung; then take it out again, and pour it out into another glass, with a wide mouth to it; expose it to the sun for a month, and you will have a concreted camphor, which is in some measure like the natural camphor: this, for use in fire-works, is pulverized by grinding it with sulphur in a mortar.

The oil of camphor is made by adding a little oil of sweet almonds to the camphor, and working it in a brass mortar with a pestle; which will turn it into a green oil.

To make Moulds for Rockets,

ROCKETS bearing the pre-eminence, and being the principal things belonging to fire-works, it is requisite to give some account of every part of them—how they are made, finished and fired. In order to do this, I shall first endeavour to give the curious some idea concerning the moulds they are formed in; these are turned commonly of close and hard wood, as of white plumb-tree, box, chesnut, cypress, juniper, Indian wood, &c. Some also are made of ivory; and for rockets of an extraordinary large size, they are cast in brass or copper, and turned in the inside in a nice manner: the foot, or basis, with its cylinder, wart, or half-bullet, may in these, as in others, remain of solid wood. The whole is commonly turned of the size and form of a column in architecture; and embellished with ornaments, according to the taste of the fire-worker.

The size of the cylinder is agreed, by the most famous artificers, to be, for rockets from a half to six pounds, six diameters; but for the larger size, four, four and a half, or five diameters of the height of the orifice.

Those rockets which go under the denomination of small ones, are those whose inward diameter cannot receive a ball that exceeds one pound. The middling sort are those whose diameter can admit balls of one, two, or three pounds; and great ones are such, whose bore will receive balls from three to a hundred pounds.

Rocket moulds, from some ounces to three pounds, are ordinarily seven diameters of their bore long; the foot, two or three diameters thick; the wart, two-thirds of the diameters; and the piercer, one-third of the bore; the roller, two-thirds, and always one or two diameters, from the handle, longer than the mould; the rammer, one diameter shorter than the mould, and somewhat thinner than the roller, to prevent the sacking of the paper when the charge is rammed in; having, always, one still shorter, that, when the shell of the rocket is rammed half full, you may use that with more ease. For the better illustration, see fig. 1. representing the mould with its basis, cylinder, bore and piercer. A B the interior diameter of the mould:—C D the height of the mould, seven diameters: from D to E is the height of the breech at bottom, which stops the mould when the rocket is driving; and this is one and one-third diameter. Upon this bottom you have a solid cylinder, whose height is one diameter of the orifice A B; this cylinder is crowned with a wart, or half bullet I, having a hole in the centre, in which is fixed the iron, or copper piercer F.—G. a pin that keeps the bottom and cylinder together. 2. The roller. 3. The rammer. 4. The shorter rammer.

It is to be observed, that some of these moulds are made nine diameters of their orifice long; the shell therefore, with the wart, will be twelve diameters. These sort of rockets fly very high, because of their length, containing a greater charge than the short; nevertheless, the piercer needs to be no longer than seven diameters, but substantial, so as to keep in its proper attitude:—it will require the dimension of two-thirds of the diameter at bottom, and from thence, tapering, to half the diameter.

To prepare Cases for Swarmers, or Rockets.

THE cases, or trunks, of rockets, are made of different sorts of things, viz. paper, wood, tin, pasteboard, linen, leather, &c.

In paper cases, which are for the most part made use of, it must be observed, 1. That great care ought to be taken in winding, or rolling them, upon the roller, tight and close. 2. That the concave stroke be struck clean, smooth, and without large wrinkles; and, 3. That each sort of cases be of an equal length and size.

The rocket-shells being very tiresome for two persons to make by hand, a machine has been invented for the casement. It is made of an oaken board, about two foot wide, and three or four inches thick, planed smooth, and cut out into channels, or groves, of different sizes, to serve for greater, or lesser, rockets; and is commonly called the saddle. To these sort of saddles are also made pressers, whereby the cases on the roller are pressed down with a heavy hand; the handle of the roller having a hole in the middle, a small iron bar is put in, and as the man presses with one hand, he turns the roller with the other; and, by this means, the paper is brought as tight as it ought to be. See fig. 5 and 6.

For four and six pound shells it is to be observed, that each sheet of paper (except the first and last, in the part where the neck is formed) be a little moistened.

The necks of rockets may be formed several ways:—for those of three quarters of a pound, a well twisted pack-thread will do, which, having one end tied to a stick and put between one's legs, and the other to a post, will draw it close with ease. The large shells require more strength; one end of a strong cord being fastened to a post, and the other to a leathern belt, with a hook, as fig. 7:—and this, by main force, draws the cord, twisted about the neck of the case,—as you see in fig. 8.

Some make use of a bench, on one end of which is fixed a post, to which a cord is fixed, and conveyed over a pully, and through a hole in the bench, to a treddle, to which it is fastened, whereby the necks are forced very tight. See fig. 9.

The necks of extraordinary large sized rockets are forced, with strong cords, over screws, and round-necked irons, proportioned to the size of the shell. See fig. 10.

The wooden, tin, and paste-board rockets, are supplied with necks, turned of wood, joined, and fastened through the sides of the shell with wooden pegs.

Preliminary Observations in preparing the Charges for Rockets; and to order their Fires of various Colours

BEFORE you begin to charge the shell of the rocket, be very careful that the powder is well worked and cleaned; that the nitre is thoroughly refined, and made into an impalpable powder; that the sulphur be well cleansed, and brought to the highest perfection; that the coals be of lime-tree, or other soft wood, well burnt, powdered, dried, and sifted; and all these ingredients be well mixed together and searsed through a fine sieve.

When you are satisfied in these things, and have weighed the proportionable quantities of each, put the mixture into the work board, fig. 11. and grind it with the grinder, fig. 12. for an hour: then try your charge, by sifting a little on a table, and if, when lighted, it burns away in an even fire, and does not fly up, it is a sign that it is worked enough; but if at one place it burns quicker than another, or stops its course, then you must grind it more. The charge being thus prepared, you must put it up safe in a place that is neither too hot, cold, nor damp, in a box, or other dry vessel; and when you charge your rocket, then sprinkle and mix the charge with a little brandy.

Having rammed a rocket, for trial, fire it in a secure open place; if it mounts even and high, and gives a report as soon as it turns, it is a sign of being made to perfection; but if the rocket burst as soon as it is lighted, then the charge is too fierce; or if it rises a little, and falls back, then the charge is foul and weak:—the former is rectified by adding more charcoal; and the latter, by some meal-powder. For the rest, it must be observed, that the larger the rockets are, the weaker must be the charge; and on the contrary, the smaller they are, the stronger must be their charge.

If you would represent a fiery rain falling from the rocket, mix among your charge a composition of powdered glass, filings of iron, and saw-dust; this shower is commonly called the peacock's tail, on account of the various colours that appear in it.

You may also exhibit a variety of colours issuing forth from a rocket, by mixing among the charge a certain quantity of camphor, which produces a white, or pale fire; rosin, a red and copper colour; blood-stone, which has been nealed and beaten to a palpable powder, a blood red; sulphur, a blue; sal ammoniac, a green; antimony, a reddish, or honey colour; ivory shavings, a shining silver; filed agate-stone, an orange; and pitch, a dark and deep coloured fire. This must be managed with discretion; and practice will be the best teacher in that particular,

cular, for long lessons are more fit to perplex a young beginner than put him forwards.

The charges are commonly divided into three sorts, or degrees, viz. white, grey, and black. I have, the better to guide beginners in this art, set down several sorts of charges, according to the proportion of rockets, but without distinguishing the three several colours; wherefore you have to observe, that to the grey charges are four ingredients, viz. mealed gunpowder *, nitre, sulphur and charcoal; to the white charges three ingredients, viz. nitre, sulphur, and charcoal; and to the black charges two ingredients, viz. mealed gunpowder and charcoal.

Charges for Land Swarmers, or Small Rockets.

MEALED gunpowder one pound, and charcoal one ounce. *Or,*

Mealed powder five ounces, and charcoal half an ounce.

Mealed powder fifteen ounces, and charcoal two ounces.

Mealed powder six ounces, nitre four ounces, sulphur one ounce, charcoal one ounce and three quarters. This last may be used for the fuzee of others.

Charges for Water Rockets.

NITRE, or saltpetre, two ounces, sulphur half an ounce, and charcoal one ounce and a half.

Mealed powder one pound and a half, nitre four pounds, sulphur two pounds, and charcoal five ounces.

Mealed powder four ounces, nitre one pound, sulphur eight ounces, and charcoal one ounce.

Nitre two ounces, sulphur half an ounce, and charcoal half an ounce.

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* Wherever the term *mealed powder*, or *powder* only, is used, it means *finely bruised gunpowder*: *corn powder* is whole gunpowder:

A general

A general Charge for Rockets of two or three Ounces.

MEALED powder twelve ounces, nitre two ounces, sulphur half an ounce, charcoal one ounce and a half.

Charges for Rockets of four, five, and six Ounces.

POWDER, *i. e.* gunpowder, fifteen ounces, nitre twelve ounces, sulphur one ounce and a half, and charcoal four ounces.

Powder one pound and a half, nitre one pound and a half, sulphur ten ounces and a half, and charcoal twelve ounces.

Powder two pounds, nitre one pound, sulphur three ounces, and charcoal fourteen ounces and a half.

Powder eight pounds, nitre twelve pounds, sulphur two pounds, and charcoal four pounds.

Powder twelve ounces, nitre two ounces, sulphur two ounces, and charcoal two ounces.

Nitre four pounds, sulphur fourteen ounces, and charcoal one pound.

Powder three ounces, nitre half an ounce, sulphur half an ounce, and charcoal half an ounce.

Powder one pound and a half, charcoal three ounces and three quarters.

For eight, nine, and twelve Ounce Rockets.

MEALED powder eighteen pounds, nitre eight pounds, sulphur one pound, and charcoal four pounds.

Powder four pounds, nitre three pounds and a half, sulphur fifteen ounces, charcoal one pound four ounces.

Powder three pounds, nitre two pounds, sulphur two pounds, and charcoal one pound.

Powder three pounds, nitre two pounds, sulphur one ounce, and charcoal one pound.

Powder nine pounds, charcoal one pound eight ounces.

Nitre two pounds four ounces, sulphur eight ounces, charcoal fourteen ounces, and antimony four ounces.

Nitre one pound two ounces, sulphur two ounces, and charcoal four ounces.

Nitre ten ounces and a half, sulphur one ounce, charcoal three ounces, and brass file-dust half an ounce.

Nitre two pounds four ounces, sulphur eight ounces, and charcoal fourteen ounces.

For one, and one and a half Pound Rockets.

MEALED powder three pounds, nitre four ounces, sulphur one ounce, and charcoal four ounces and a half.

Powder thirty-two pounds, sulphur two pounds, and charcoal six pounds.

Powder two pounds, nitre two pounds and a half, sulphur twelve ounces, and charcoal one pound three ounces.

Powder six pounds and a half, charcoal one pound.

Powder three pounds, nitre fifteen ounces, sulphur four ounces, and charcoal seven ounces and a half.

Powder four pounds, nitre one pound eight ounces, sulphur ten ounces, and charcoal one pound twelve ounces.

Powder two pounds, nitre one pound four ounces, sulphur one ounce, and charcoal eight ounces and a half.

For two and three Pound Rockets.

MEALED powder three pounds eight ounces, nitre three pounds ten ounces, sulphur one pound four ounces, and charcoal one pound three ounces.

Nitre four pounds eight ounces, sulphur one pound eight ounces, and charcoal one pound four ounces.

Nitre sixty pounds, sulphur two pounds, and charcoal fifteen pounds.

Powder two pounds thirteen ounces, nitre fifteen ounces, sulphur four ounces, and charcoal seven ounces and a half

Powder twelve ounces, nitre one pound eight ounces, sulphur six ounces, and charcoal six ounces.

Powder four pounds, nitre nine ounces, sulphur three ounces and a half, and charcoal ten ounces and a half.

Powder one pound, nitre eight ounces, sulphur two ounces, and charcoal three ounces.

Powder eleven pounds, and charcoal two pounds ten ounces.

Nitre six pounds four ounces, sulphur one pound, and charcoal two pounds and a half.

For four or five Pound Rockets.

Mealed powder six pounds, nitre four pounds, sulphur one pound and a half, and charcoal two pounds six ounces. *Or,*

Nitre sixty-four pounds, sulphur eight pounds, and charcoal eight pounds.

For six, eight, or nine Pounders.

Mealed powder twelve pounds three quarters, nitre six pounds, sulphur two pounds and a half, and charcoal five pounds and a half. *Or,*

Nitre thirty-five pounds, sulphur five pounds, charcoal ten pounds.

Mealed powder twenty-two pounds and a half, and charcoal five pounds twelve ounces.

Mealed powder one pound, nitre half a pound, sulphur two ounces, and charcoal three ounces.

Nitre nine pounds, sulphur one pound nine ounces, and charcoal three pounds and a half.

For ten and twelve Pounders.

Nitre sixty-two pounds, sulphur nine pounds, charcoal twenty pounds.

Powder eleven pounds, nitre seven pounds, sulphur three pounds, and charcoal six pounds.

For

For fourteen, fifteen, and sixteen Pounders.

POWDER ten pounds and a half, sulphur nine pounds three quarters, and charcoal seven pounds.

Nitre twenty-three pounds, sulphur eight pounds, and charcoal sixteen pounds.

For eighteen or twenty Pounders.

POWDER twenty-two pounds, nitre sixteen pounds, sulphur seven pounds, charcoal thirteen pounds and a half.

Nitre twenty-four pounds, sulphur twelve pounds, and charcoal twenty-six pounds.

For thirty, forty, and fifty Pounders.

POWDER eight pounds, nitre sixteen pounds, sulphur two pounds, and charcoal four pounds.

Nitre thirty pounds, sulphur seven pounds, and charcoal eighteen pounds.

For sixty, eighty, and a hundred Pounders.

NITRE thirty-six pounds, sulphur ten pounds, and charcoal eighteen pounds.

Nitre fifty pounds, sulphur twenty pounds, and charcoal thirty pounds.

To bore the Rockets, or ram them over the Piercer.

SINCE the boring of rockets is one of the principal things belonging to them, (for their operating well) the bores are to be made in proportion to the size of the rockets; some of them are bored tapering to a point; others are hollowed square, running also to a point; and others are rammed over a round piercer, which is fixed in the wart of the rocket-mould. See fig. 1. I, which stands perpendicular, running tapering to a point. The stronger the charge of the rockets, the narrower should be the bore; and the weaker the charge, the deeper and wider:—for if a strong charge is bored too deep, it will break in ascending; and if it is bored too little, and the charge too slow, it will fall to the ground without any effect:—they are commonly, in middling charges, bored two-thirds of the tube from the neck.

The boring must be performed strait and even; and although some will give themselves the trouble to bore them by hand, it is better, when a quantity is to be bored, to send them to a turner.

The rockets should be bored but a few days before they are to be used; and kept in *dry places;* which you must also observe in other materials for fire-works.

For garnishing of Rockets.

THIS is done several ways, for they may be both within and without furnished with crackers. On the outside it is done in the following manner, viz. That end of the rocket which is solid is divided into three equal parts, and then bored in the middle of each, quite to the charge; at the bottom of these holes paste a ring of thin paper, upon which fling some mealed powder; then fix in the crackers, stuffing the sides with some tow or flax; and over that, paste a covering of paper, to close the opening between the rocket and crackers.

The inside is finished thus: put a small round board (in which you have bored several holes) upon the charge; then strew mealed powder in them, and fix your crackers; cover it with a cap, and paste it to the outside of the rocket.

You may also furnish rockets, both within and without, with sparks, stars, and fire-rain, when those materials are joined either within or without. You may also fix to the large rockets, swarmers, by boring a touch-hole in both, filling them with mealed powder, and, after the touch-holes are fixed exactly on one another, glue them together with a bandage of paper; thus you may mark a winding figure with a thread on a rocket, and place your swarmers accordingly. See fig. 13. You may also, instead of swarmers, place a globe on the top of the rocket, charged with the composition of rockets, and filled with crackers; this globe must have a touch-hole, and be lighted before the rocket is let off, and it will have a good effect. Several other things may be done that way, as the genius of every virtuoso will direct him. See fig. 14, 15.

How to proportion the Rocket-Poles and Sticks.

It is common to tie but one rocket to a stick; but six or seven may be placed round the thick end, which must be worked with grooves, as you see fig. 17. But as no rocket would ascend high, if it were not for the true balance observed in the pole or stick, you must further observe, that these sticks are made of light, dry, and strait wood, and must (to one and two pound rockets) be seven times as long as the rocket; which proportion, of the small ones of seven diameters, must also be observed in the larger sort. That end where the rocket is tied to, must be two-fifths; and below, one sixth of the diameter. It is best to give the turner an unbored rocket, and one that is bored, thereby not only to measure the length, but also balance the weight. After the rocket is tied to the stick, take it four inches from the neck of that rocket which is not yet bored; and from the neck of the bored one, about two or three fingers, so as to stand on the back of a knife, or one's finger, in an equilibrium. In large rockets, the poles must be eight or nine rockets long; and to find their balance, you take their libration twelve inches from the neck.

Rockets without Sticks.

There are rockets made without sticks. Fix to the small ones (from four, to eight, nine, or ten ounces after they are bored and rammed) four wings, in the nature of arrow-feathers, made either of light wood or paste-board, and glued crossways to the rocket: their length must be two-thirds; and the breadth, below, one-sixth of the length of the rocket; the thickness may be one-eighth of the diameter of the mouth. See fig. 18, and 19. These sort of rockets are fired on a board or stand, placed between four small sticks; as you see in fig. 20.

Others fasten one end of a wire, which is about a foot long, twisted like a screw, to the mouth of the rocket, and hang an iron ball to the other end, of an equal weight with the rocket. See fig. 21.

Of Girandel Chests; how, and with what, the Rockets are fired therein.

THE girandel chest, see fig. 16, is made of wood, of what size you think proper, according to the number of rockets you design to fire at once.

The method of firing the rockets is performed several ways; some fill the necks of them with mealed powder; others, with quick match; wherewith, or with gun match, they fire them: the best way to light the girandel, or other fire-works, is with a match, prepared on purpose in the following manner:

Cut some slips of paper, of the length of half a sheet, and about one or two inches wide; roll, and glue, each of them together over a little round and smooth stick, of a quarter of an inch thick; this done, take it off, when dry, and fill it with the composition hereafter-mentioned; ramming it in, by little and little, with a less stick than that upon which you rolled the shell. These sort of matches are put upon pinchers, as you see in fig. 22; and when they are lighted, they cannot be extinguished either by rain or wind.

Their

Their Composition.

MEALED powder three ounces and a half, nitre seven ounces, and sulphur three ounces three quarters, moistened with linseed oil.

Mealed powder one pound, nitre one pound, and sulphur thirteen ounces, moistened with linseed oil.

Mealed powder one pound, nitre one pound four ounces, sulphur four ounces, charcoal two ounces, resin two ounces and a half, moistened with turpentine and linseed oil, and worked well together.

Mealed powder twelve ounces, nitre two ounces, sulphur three ounces and a half, charcoal an ounce and a quarter, turpentine one ounce, and tallow three ounces and a quarter; first melt the turpentine and tallow together, then stir the other ingredients among it, and pour it in the paper shells; when dry, they are fit for use.

Of Rockets that run upon Lines, or Ropes, from one place to another.

THESE are made several different ways; and to give them the more shew, some garnish them with figures of various devices.

The first sort is contrived by fixing two iron rings, or a wooden tube, to a rocket, filled with a certain quantity of a suitable composition, and bored as usual; through these rings, or tubes, is put a line, on which the rocket is to run; this is of the most simple kind, for being arrived at the place where the duration of its combustible matter will allow it to reach, it there stops. This sort is represented in fig. 23.

For the second sort, fill any rocket, whose orifice is equal to that of the former, but much longer, to the height of four diameters; bore it to the depth of three and a half. Upon this composition put a cap, or little wooden partition, without any hole through it; glue this to the inside of the rocket, or secure it any other way, to prevent the fire, when arrived at that place, from catching hold of the composition contained in the other part of the case. This done, charge the remainder of the rocket to the same height as before, viz. to four diameters (three and a half must be bored); after this choak the rocket at top, and make a little receptacle for the priming, as at the other end; or else, fit a round piece of wood to it, with a hole through the middle, as you see in A, fig. 24. which you cover with a little cap; to this add, on one side, a tube made of very thin iron plate, which fill with mealed powder; then bore a hole through the side of the rocket, near the other side of the partition that is in the middle, and fill it with mealed powder; this is done to convey the fire through the tube to the receptable A, where it lights the other rocket, and consequently obliges it to return back to the place whence it came; the upper part which holds the priming must be covered with paper, as well as the small tube that conveys the fire from that to the other end. This rocket must also have two iron rings, or a wooden tube, to run along the line. You may make the diversion the greater, by tying small paper crackers all round. The contrivance of this rocket is very pretty. You have the representation plain in fig. 24, 25.

The decorations and devices that are usually fixed to these running rockets, may be either flying dragons, pigeons, Mercuries, Cupids, or any other fancy, as the occasion of a feast or rejoicing requires.

Charges for the Line Rockets.

MEALED powder three ounces, nitre one ounce and a half, and charcoal three ounces, will be a right proportion for three, four, or six ounce rockets.

Mealed powder eight ounces, nitre two ounces, sulphur half an ounce, and charcoal one ounce.

Mealed powder nine ounces, nitre one ounce, sulphur three quarters of an ounce, and charcoal four ounces.

Mealed powder fourteen ounces, nitre seven ounces, sulphur two ounces, and charcoal four ounces.

These charges may be used for sixteen and twenty-four pounders.

Mealed powder one pound, nitre half a pound, sulphur three ounces, and charcoal five ounces. This charge is proper for three quarters and one pound line rockets.

It will be adviseable to make some trials of the charges, that you may be sure of not failing in the performance: see fig. 23, 24, 25, where *a* is the rocket; *b* the tube, or, instead thereof, some rings that slide upon the cord; *c* the partition; *d* the pipe, for the communication of the fire from one rocket to another.

How to join two Rockets to one another, the one to burn in the Water, and the other suddenly to fly up into the Air.

TAKE two rocket shells of equal dimensions; fill one with a good charge, quite full; the other charge, bore and tie to a stick, as usual; the former you glue, upside down, to the middle of the latter; and, towards the end, tie it round with a cord, which is somewhat longer than the rocket stick; to the end thereof fasten a ring, and, in that, a leaden ball, which is to keep both rockets in a due position on the surface of the water; through this ring put the end of the stick, which is provided with a cross that is somewhat wider than the diameter of the ring, and keeps the cord, ring and ball under water: the communication of the fire must be made below the rockets, by a small pipe, filled with mealed powder very secure, so as to keep it from the water; for, as soon as the water rocket is burnt to the end, the fire will make its way through the pipe, and the land rocket will disengage itself by its force from the case of the other, and leave the cord, ring and ball, behind in the water: see fig. 26.

How to make Water-rockets, Water-brands, Water-cats, Water-ducks, &c. that turn themselves in the Water.

THE cases for the water-brands, and also their sticks, must be made something longer than ordinary, and be filled with a composition of coarse coal-dust, small rubbed tanner's-bark, or saw-dust, but in the same method as sky-rockets. The whole case is to be nine or ten diameters long, and must be divided into five equal parts, and be charged two-fifths full of composition: upon this, charge a report of a quarter high, and upon that, fine iron flakes, in order to sink it; then cover it with paper, and draw it together with a cord;--the charge is lifted up a little in the neck, and supplied with brandy-dough, or mealed powder moistened with brandy, and glued over with paper; and having fixed a wooden swimmer below the neck, it is dipped in wax and pitch, and is ready for use.

Water-crackers, which turn in the water, are thus prepared:

This case is made nine or ten diameters long; the neck is drawn quite close, and charged with mealed powder almost half full: upon this, a partition is made with a hole in it; then put corned powder for a report; upon that is placed another partition; the rest is filled with mealed powder, and the end tied close, and the paper cut short at both ends; when these crackers are to be fired, make a touch-hole at the end of both, reversed, and having filled them up with mealed-powder, and covered them well with brandy-dough, you may fire and fling them into the water, having before dipt them in melted wax, or pitch.

It is to be observed, that, to the water cat-cases, we may proceed thus (from one ounce to half pound crackers); but, if larger, they are too heavy, and will not so soon turn up again in the water, till some parts of them are consumed; wherefore, to remedy this, put in the case, first, three measures of charge; upon this, put a little corn powder; then again, two measures of charge, and a little corn powder, and proceed thus as far as the report; upon the charge is placed a partition of wood, with a hole in it; on that, a report of good corn-powder; then tie it close: further, open it a little, putting some mealed powder to it mixed with brandy; and when you would use it, anoint it all over with grease or linseed oil. The water-crackers, or divers, are commonly rammed in one, one and a half, and two ounce, cases, stratified in the manner just mentioned, taking two measures for each lay of water cat-charge, and a little corn powder between each.

There are other sorts of rockets, that may be represented swimming on the water: these are made in the same manner as the one, or one ounce and a half rockets, bored one-third in the charge, then put into a paper cylinder with two small wooden heads, or bases, having a hole bored to the centre of each: the height of this cylinder must be equal to half of the rocket, and the hole through the centre of each head fitted exactly to the rocket; when you have fixed every thing to a nicety, put it into melted wax, or pitch; and when cold, you may fire and fling it into the water. See fig. 27, 28, 29.

You may also put these sorts of rockets into a paper cone, and fasten it to the neck of the rocket; or else in a bladder full of wind, which, instead of dipping in melted wax, do over with a mixture of four parts of linseed oil, two parts of bole armenic, one part of white lead, and half a part of ashes. See fig. 30, 31.

You may mix along with the reports of the rockets, certain sparks and stars, intermixed with meal and corn powder; to this is fixed an iron or wooden tube; from each end of this goes another smaller tube, all having communication with one another. These are filled with mealed powder, covered over with paper, dipped in wax or pitch, and a counterpoise being fixed below, it is fired. As soon as the composition is burnt down to the cap, it is conveyed through small tubes to the lower part, where beating out the partition, it disperses the powder, stars, &c. into the air. See fig. 32.

Charges for Water-rockets.

MEALED powder six ounces, resin one ounce, charcoal three quarters of an ounce, nitre one ounce, corn powder one ounce.

Nitre one pound, sulphur eight ounces, mealed powder eight ounces, and charcoal four ounces and a half.

Nitre four ounces, sulphur three ounces, and charcoal three quarters of an ounce.

Mealed powder one pound and a half, nitre half a pound, sulphur four ounces and a half, charcoal six ounces, coarse coal two ounces and a half, and lead, for sinking, one ounce.

Mealed powder two pounds, nitre one pound, sulphur ten ounces, charcoal eight ounces, coarse coal three ounces, sinking lead one ounce and three quarters (for three quarter ounce rockets.)

Mealed powder two pounds, nitre two pounds, sulphur one pound, charcoal four ounces, coarse coal three ounces, tanner's-dust two ounces and a half, saw-dust two ounces, glass powder one ounce, sinking lead one ounce and three quarters, for one pound rockets.

Mealed powder half a pound, nitre three quarters of a pound, charcoal five ounces, saw-dust half an ounce, and a quarter of an ounce of fine chopped cotton, boiled in nitre lye.

Charges for Water-crackers.

MEALED powder two pounds and a half, nitre one pound and a half, sulphur ten ounces, charcoal eleven ounces, coarse coals nine ounces; the sinking is, to two ounce crackers, a quarter of an ounce of lead.

Mealed powder two pounds and a half, nitre two pounds and a half, sulphur one pound five ounces, saw-dust twelve ounces, charcoal three quarters of a pound, coarse coals half a pound; the sinking, a quarter of an ounce.

Mealed powder four ounces, nitre five pounds, sulphur two pounds and three quarters, tanner's-dust one pound and a half, charcoal one pound, coarse coals two pounds and three quarters, glass-dust four ounces, lead three quarters of an ounce to sink it.

Charges for Tumbling Water-crackers.

MEALED powder one pound, nitre one ounce, and charcoal one ounce and a half.

Mealed powder one pound, nitre eight ounces, sulphur three quarters of an ounce, and charcoal one ounce and three quarters.

Mealed powder three quarters of a pound, charcoal four ounces; for one and a half, or two pound rockets.

Charges for Water-cats.

MEALED powder two parts, nitre four parts, sulphur one part, coarse coals two parts, saw-dust two parts, and antimony three parts, moistened with linseed oil.

Mealed powder two ounces and a half, nitre three ounces and a half, sulphur two ounces and a half, and antimony half an ounce.

Mealed flour one pound, nitre two pounds, sulphur one pound, and charcoal one pound.

Nitre fifteen ounces, sulphur five ounces, saw-dust eight ounces, and antimony two ounces.

Some general Remarks upon Rockets.

1. YOUR rockets must have their proportionable height, according to the diameters of their orifices.

2. Their necks must be drawn, or choaked, firm; and, to prevent the cord giving way, they must be glued over.

3. Prepare your composition just before you want it.

4. Let it be neither too damp nor too dry, but sprinkle it over with a little oily substance, or a little brandy.

5. When you drive your rockets, put always equal quantities of composition in your cases at a time.

6. Carry with your mallet an even and perpendicular stroke, when you charge your rockets.

7. The cavity must be bored upright and perpendicular, exactly in the middle of the composition.

8. Bore your rockets just before you use them; then handle them carefully, lest their form should be spoiled.

9. Let the sticks and rods be well proportioned, strait and smooth.

10. Put your rockets, when completed, in a place that is neither very damp nor dry.

11. Let most of your rockets have at top a conic figure, by that means they will the easier shoot through the air.

12. Avoid, if possible, a damp, foggy, rainy or windy night, to play your rockets.

Defective Rockets are chiefly discovered by the following Observations.

1. WHEN they are fired, and in mounting two or three perches, they break and disperse, without performing their proper effects.

2. When they remain suspended on the nail, and waste away slowly, without rising at all.

3. When they form an arch in their ascent, or a semicircle, and return to the ground before their composition is burnt out.

4. When they mount in a winding posture, without an uniform motion.

5. When they move on slowly and heavy.

6. When the cases remain on the nails, and the composition rises and disperses in the air.

More of these vexatious accidents will sometimes frustrate the hopes of a young practitioner; but as the above are the principal ones, he must endeavour to avoid them in his first beginning.

Of Rocket-flyers, and the Manner of charging them.

THESE are of two sorts, namely, the single and double; the latter are made after the following manner:

Have a nave, or button, turned, the dimension of three inches, together with two knots upon it, perpendicular, one against the other, of an inch and a half long, and so thick that both rocket-cases may fit over them; (there must be a hole, of the third of an inch in the centre of the nave, for the iron pin to go through, on which it is to fly;) after this, take two rocket cases, of equal dimensions, which are choaked quite close at the neck, and glued: ram in the charge, so far as to leave only room to fix them on the two knobs upon the nave: this done, bore into both rockets, near the closed-up necks, small touch-holes, (and one more near the pin) in that which is to burn first; from this hole, carry a little pipe to the hole near the neck of the other rocket, having first filled it with mealed powder, that when the rocket is almost burnt out, the second may be lighted by the first. The three touch-holes are to stand in one row; and you may on the other side fix a couple of reports, which will cause a swifter motion.

The single flyers are made with more ease; the neck in these must not be tied close, as in the former, but they must be fired in that place; but these do not turn so well as those that are made double.

Of Fire-wheels.

Of these there are three sorts, viz. single, double, and triple; some of their fells are of a circular form, others an hexagonal, octagonal, or decagonal form; some like a star, without fells; some, and the most of them, are made to run perpendicular to the earth; others horizontal; all may be ordered so as to serve either on land or water.

Horizontal wheels are often fired two at a time, and made to keep time like vertical wheels; only they are made without any slow or dead fire: ten or twelve inches will be enough for the diameter of wheels with six spokes. Fig. 34, represents such a wheel on fire, with the first case burning.

The fire-wheels that are used on land, turn upon an iron pin or bolt, drawn or screwed into a post. The nave is turned of close and firm wood, in which the joiners glue the spokes, according to the number of the fells, which must be carefully joined together; then have a groove hollowed round, so deep that the rocket or case may be about half lodged therein. See fig. 35.

The double wheels must have their fells turned stronger and wider, with a groove for the rockets, not only at top, but also on one side thereof; plying the necks of the rockets at top, to the right, and those of the sides to the left hand. See fig. 36.

Your rockets being ready, and cut behind a little shelving, bore them; the first, three diameters of its orifice; the second, two and three quarters; the third, two and a quarter; the fourth, two diameters; the fifth, one and three quarters; the sixth, one and a half; the seventh, one and a quarter; the eighth, one diameter; always the latter something shorter than the preceding:--after this, they are primed with mealed powder worked up with brandy, and when dry, glued in the above described grooves; you must bear the first-fired rocket's neck above the rest, underlaying it with a tin plate, or any thing else, the same you must observe in the head of the last fired one, wherein you put the charge of a report; you may also glue on every end of the rockets, a report of paper, with small pipes of copper, or goose-quills, which are fixed one end in the side of the rocket, and the other in the report. When all is dry, then you may cover your wheel on one or both sides, with linen or paper, in what form you would have it.

Of Tourbillons.

HAVING filled some cases within about one and a half diameter, drive in some clay; then pinch their ends close, and drive them down with a mallet; when done, find the centre of gravity of each case, where nail and tie a stick, which should be half an inch broad at the middle, and a little narrower at the ends: these sticks must have their ends turned upwards, so that the cases may turn horizontally on their centres: at the opposite side of the cases, at each end, bore a hole close to the clay with a gimlet; from those holes draw a line round the case, and at the under part of the case bore a hole, with the same gimlet, within half a diameter of each line towards the centre; then from one hole to the other draw a right line: divide this line into three equal parts, and at X and Y, fig. 38. pl. 2. bore a hole, and from this hole to the other two, lead a quick match, over which paste a thin paper.

A fire wheel which is to whirl horizontally in the water must be thus ordered:

Take a pretty large wooden dish, or bowl, that has a broad flat rim (see fig. 39;) also a smooth dry board, something larger than the dish, and formed into an octagon; in the middle of this board make a round hole that will hold a water-ball, so that one half be received in the dish, and the other half rise above the surface of the board; nail this board upon the rim of the dish, and fix the ball in the middle, tying it fast with wire; then glue your rockets in the grooves which are made round the edges of the board, laying them close to one another, so that successively taking fire from one another, they may keep the wheel in an equal rotation. You may add, if you please, on each side of the wheel, a few boxes, filled with crackers or cartouches, erected perpendicular; and also fix double and single crackers, following in a range, one after another, for two or three fires; or as many as the extent of the wheel will admit.

For your private fuzees, observe that you conduct one from the rocket, which is to be fixed to the composition of the ball, in a channel.

Fill these channels with mealed powder, and cover them close with paper: also lay a train of fusees of communication from the rockets to a cartouch, and from that to the rest. See fig. 40.

Lastly, when all is ready and covered, dip the whole machine into melted pitch, and secure it from the injury of the water; the ball is fired first, and, when lighted, you place it gently on the surface of the water, and then fire the rocket.

To try a fire-wheel; first weigh one of the rockets, and tie it to a fell, with cord, and according to the weight, fill little long bags full of sand, tying them likewise on the rest of the fells; then, hang the wheel on an iron pin, and fire the rocket, and if it turns the wheel, then you may assure yourself it will be complete.

Wheels formed like stars, are to have their spokes fixed upright in the nave, like other wheels, only with grooves on one of the sides of each, where you glue the rockets; at the bottom of each rocket is made a little hole, whence the fire is conveyed through little pipes, filled with mealed powder up to the next, and so on, all round; then cover it with linen cloth, or paper, in the shape of a star, and place it on the iron axis.

Observe, that all the rockets used in fire-wheels have their necks tied close, leaving only a small conveyance from one rocket to another:—the last of all must be well secured below, where you may place a strong report of corn powder.

Charges for Fire-flyers and Wheels, of four, five, and six Ounce Rockets.

Mealed powder three pounds, nitre two pounds, charcoal five ounces, and sea-coal three ounces.

Mealed powder fourteen ounces, nitre six ounces, charcoal three ounces and a half, sulphur three ounces, and sea-coal three ounces.

Mealed powder fifteen ounces, nitre six ounces, sulphur three ounces, and charcoal three ounces.

Nitre five pounds, sulphur three quarters of a pound, charcoal one pound four ounces.

These charges are bored with a round bodkin.

Mealed powder two pounds, sea-coal eight ounces, and charcoal ten ounces.

Mealed powder three pounds, sulphur eight ounces, and charcoal ten ounces.

These charges may be used for triple wheels, and must be bored, one-third, with a bodkin.

For Wheels of one Pound Rockets.

MEALED powder six pounds, nitre three pounds, sulphur one pound seven ounces, charcoal two pounds nine ounces, and tanner's-dust one ounce.

The bore must be an inch and a half.

For Wheels of one and a half, and two Pound Rockets.

MEALED powder six pounds, nitre three pounds and a half, sulphur one pound and a half, charcoal two pounds three quarters, and saw-dust one ounce and a half.

The first rocket in the wheel is, in length, two diameters and a half of its orifice.

For Wheels of three and four Pound Rockets.

MEALED powder nine pounds, nitre one pound and a half, sulphur one pound two ounces, and charcoal three pounds four ounces.

The first rocket is bored but one and a half of its diameter.

TO MAKE SINGLE AND DOUBLE CARTOUCHES, OR BOXES, TUBES, STARS, SPARKS, &c.

WHEN some hundred boxes or cartouches are adjusted and fixed in machines of great fire-works, they afford among the towering rockets great delight to the spectators. These boxes are made either of wood, paste-board, or copper; and are charged and proportioned according to their strength. If made of wood, they must fit exactly, and receive each other, so as to seem but one continual piece; and if paste-board, you must glue on a foot at bottom, of a hand high, to each of them: the inside of these machines must exactly fit and correspond with the outside of the cartouches themselves, and be so contrived as to slip into one another.

The engine, fig. 41, is very proper for the construction of those boxes, and represents the bench: the other, fig. 42. shews the cylinders, upon which, (having greased them first over with soap) you fashion your boxes, just as you think proper, by pasting one thickness of paper upon another, and fixing a handle to the end of the cylinder.

Having formed them, put them to dry in a moderate heat; too great a heat will shrivel them up; when dry, take one after another off the cylinder, and immediately clap round wooden bottoms (the edges being first done over with glue) into them, and sprig them on the outside, to make them secure.

The single boxes are to be changed in the following manner:

1. Put in some corn powder.

2. Upon that charge, fix a round paste-board, well fitted to the concave side of the box, which has five or six small holes, and is on both sides laid over with mealed powder tempered with brandy.

3. Put upon the paste-board a little mealed powder, and upon that, well pierced crackers, so as to stand with their necks downwards: the principal rocket is put in the middle, with the neck downwards, open at both ends; so that being lighted above, and burning down, it may fire the rest of the crackers, which are blown up in the air by the corn powder.

4. The empty spaces between the large fire-case and the crackers, are carefully filled up, and the cartouch is stuffed at top with tow, or else with saw-dust boiled in nitre lye.

5. The cartouch is covered with a cap, which is glued very closely thereon; and for the great case reaching out

of the cartouch; make in the middle of the cap a hole, through which it is put, and close the opening by glueing some slips of paper round it. The fire-case is loose, covered with a paste-board cap.

Double Boxes, or Cartouches.

In fig. 43, is exhibited the construction of a case, called a double one; to enlarge on the description thereof seems to be needless, only observe, that the bottoms of the upper boxes serve for the covers of the lower, a hole being made, through which the composition of the lower box is fired, after the upper rocket has forced away the empty box, which already has discharged its load. The upper box you cover, as has been shewn above. If there are more than two cartouches upon one another, they are called Burning Tubes, which, when fired, shorten by degrees, the cartouches following one another till all are fired; some are intermixed with artificial globes, and several other fancies, which afford great pleasure to the spectators.

These boxes, or cartouches, are placed in long cases made for that purpose. The vacancies about the cartouches may be filled up with sand. See fig. 44.

Another Sort of Fire Tubes.

These are made of solid, hard, and dry wood, of what height and thickness you think proper. Bore the middle of the wood one-third, or a quarter of its diameter, after which divide the whole height into equal parts, each exactly corresponding with the sky-rockets you design to fix upon them, but rather a small matter shorter: all these divisions are cut sloping downwards, except the uppermost, which must run out in a cylinder. On the rims of each of these divisions make a groove all round, of about a

finger's

finger's breadth; in these grooves bore small holes, by which the fire may be conveyed through pipes from the cavity of the tube, to light the rockets that stand behind the paper cartouches, which must be made secure to the wood, lest they should fly up along with the rockets.

The construction of the hollow tube in this and other such-like tubes is expressed in fig. 15. A, the fire-stars and sparks, interspersed with corn powder. B, a box filled with paper or crackers. C, a fire-ball, or water-globe, which you please. D, another box filled with crackers. The hollows between these fires are filled up with corn powder, to blow up the globes and boxes one after another.

The stars and sparks made use of on this occasion are prepared in the following manner:

Take of beaten nitre five pounds and a half, mealed powder two pounds four ounces, and sulphur one pound twelve ounces.

Mealed powder three pounds, nitre six pounds, sulphur one pound, camphor half an ounce, tanner's-bark two ounces, or else saw-dust; all finely sifted and moistened with linseed oil.

Mealed powder one pound, nitre four pounds, sulphur half a pound, and pounded glass six ounces, moistened with linseed oil.

Nitre half a pound, sulphur two ounces, antimony one ounce, and mealed powder three ounces.

Nitre half a pound, sulphur three ounces, antimony one ounce, and iron file-dust half an ounce.

Nitre two pounds, mealed powder ten pounds, and sulphur one pound.

Nitre one pound, sulphur half a pound, mealed powder three ounces, and antimony one ounce.

Nitre one pound, sulphur two ounces, powder of yellow amber one ounce, crude antimony one ounce, mealed powder three ounces.

Sulphur two ounces and a half, nitre six ounces, fine mealed powder five ounces; frankincense in drops, mastich, corrosive-sublimate, of each four ounces; white amber and camphor, of each one ounce; antimony and orpiment, of each half an ounce.

These ingredients being well beaten, and finely sifted, must be sprinkled over with a little glue or gum-water, and formed into little balls, of the bigness of a small nut, then dried in the sun, or near a fire, and laid up in a dry place, to be ready, on occasion, for playing off with fire-works. When you use them, wrap them up in tow.

The following Stars are of a more yellow Cast, inclining to white.

Take four ounces of gum-tragacanth, or gum-arabic, pounded and sifted through a fine sieve, camphor dissolved in brandy two ounces, nitre one pound, sulphur half a pound, coarse powder of glass four ounces, white amber one ounce and a half, orpiment two ounces; incorporate them, and make balls of them, as directed before.

Sparks are prepared thus.

Take nitre one ounce, melted nitre half an ounce, mealed powder half an ounce, and camphor two ounces; having melted these things by themselves (only when you use them) in an earthen pot, pour on them water of gum tragacanth, or brandy that has gum arabic, or gum tragacanth dissolved in it, that the whole may have the consistence of a pretty thick liquid; this done, take one ounce of lint, which before has been boiled in brandy, vinegar, or nitre; when dry, throw it into the composition, and mix and stir it about, till it has soaked it up; then roll them up in pills, about the size of great pinsheads, and set them to dry, having first sprinkled them with mealed powder.

Some of these pyramidical tubes and fire-works, are now and then fired in large rooms, upon grand entertainments, in miniature, wherein are employed odoriferous pills, and other ingredients, that have a fragrant smell; these pills are commonly composed of *storax calamita*, benjamin, gum-juniper, of each two ounces; *olibanum*, mastich, frankincense, white amber, yellow amber, and camphor, of each one ounce; nitre three ounces; lime tree-coal four ounces; beat these ingredients very fi. pulverize and incorporate them together, and moisten with rose-water wherein you have dissolved some gum arabic or gum tragacanth; you may form them into pills, and dry them in the sun, or before a fire.

Single Tubes, or Cases.

THESE are only filled with compositions, and to the outside are fastened some crackers, serpents, or cartouches; these cases being generally round and uniform, like a cylinder, you are to trace out a winding line from the top to the bottom, on which cut holes to the depth of two or three inches. See fig. 46. Into these holes contrive to fix paper-cases with wooden bottoms, wherein you may put any sort of rockets you please; but take care you provide little holes, to lead from the great tube to the corn powder under these rockets.

Another fire tube is delineated, fig. 47. This is surrounded with cartouches, disposed in a serpentine order, like the first, which are glued and nailed as secure as possible; out of these are dispersed great numbers of squibs. As for the rest, they have nothing but what is common in others.

Another Fire Tube.

The circumference of a cylinder is, by a cord, divided into a certain number of equal parts, and being brought into a poligonal figure, cutting away the convex part, it is brought into angles.

Bore the plain sides with a number of holes, perpendicularly, so as to penetrate obliquely to the great boring in the middle: into these holes thrust crackers, squibs, or serpents.----See fig. 48.

Fig. 49, exhibits a tube, whose length is six diameters of its thickness. The cylinder being divided round the rim into six parts, and each of those into seven parts, reserve one of them for the list, between each of which make channels, which being six in number, place little mortars of the same dimensions therein.

The mortars must be turned of wood; bore the bottoms, and add a chamber to them; each chamber must be one-third, or one-half, of the depth of the fluting; and the breadth, one-sixth only. These chambers are designed to hold corn-powder.

Square the mortars on the outside with strong paper cases, and nail them fast in the hollow channels, whose cavity they are to fit exactly; their length may be double to their breadth:—each mortar must contain a globe made of paper, with a wooden bottom; and their chambers must be charged with corn-powder.

These mortars fix in a spiral line, one only in each fluting, with iron stays, and bind the middle with an iron plate, fastened on each side of the interstices; but before you fix the mortars, you must not forget to pierce little holes in the tube, and to fix the touch-holes of your mortars exactly upon them, priming both with mealed-powder. Every thing relating to this may be plainly conceived in the figure, where A and B describe the mortars, and C the globe or cartouch.

Of Salvo's.

THESE, in fire-works, are a great number of strong iron reports, fixed either in a post or plank, and, with a fire, discharged at once.

Charges for Cartouches, or Boxes.

MEALED powder six ounces, nitre one pound eight ounces, sulphur four ounces, and charcoal four ounces and a half.

Mealed powder fourteen ounces, nitre five ounces, sulphur two ounces, and charcoal three ounces.

Mealed powder one pound, nitre three quarters of a pound, sulphur four ounces and a half, tanner's-bark or saw-dust two ounces, and charcoal four ounces.

Charges for Fire Tubes.

MEALED powder six pounds, nitre four pounds, charcoal two pounds, resin half a pound, tanner's-bark five ounces, moistened with a little linseed oil.

Mealed powder three-quarters of a pound, nitre four pounds, sulphur ten ounces, and saw-dust four ounces. This charge may be used dry.

Mealed powder five pounds, nitre three pounds, charcoal one pound six ounces, resin three-quarters of a pound; not moistened.

A Preservative for Wood against Fire.

THIS being a necessary article in the execution of fire-works, it will not be improper to set it down in this place.

Take brick-dust, ashes, iron-filings, pulverized, of each an equal quantity; put them together in a pot; pour glue-water or size upon them; then put them near the fire, and, when warm, stir them together. With this size, wash over your wood-work; and when dry, repeat it, and it will be proof against fire.

The Manner of preparing, and making Letters and Names in Fire-works.

Burning letters may be represented after several methods.

Order a joiner to cut any capital letters, of what length and breadth you please, or about two feet long, and three or four inches wide, and an inch and a half thick, fig. 50. —hollow out of the body of the letters a groove, a quarter of an inch deep, reserving for the edges of the letters a quarter, or half, an inch of wood. If you design to have the letters burn of a blue fire, then make wicks of cotton or flax, according to the bigness and depth of the grooves in the letters, and draw them leisurely through melted sulphur, and place them in the grooves; brush them over with brandy, and strew mealed powder on; and, again, with brandy and thin dissolved gum-tragacanth, and on that strew mealed powder also; when dry, drive small tacks all round the edges of the grooves, and twist small wire to those tacks, that it may cross the letters, and keep the cotton or flax close therein; then lay over it brandy paste; strew, over that, mealed powder; and, at last, glue over it a single paper.

If you would have the letters burn white, dissolve six pounds of nitre, and add to it a little corn-powder; in that dip your wicks of cotton or flax. You may, instead, use dry touchwood, cut into pieces of an inch thick; put them in melted nitre over a fire; let them lay till the nitre is quite soaked through the wood; after which, mix powdered nitre with good strong brandy; take some cotton, and with a spatula, or your hands, work that, the nitre and brandy, together; then squeeze it out; strew the cotten over with powdered nitre, and make wicks; having first placed the touchwood in the grooves, lay the wicks over that and the vacancies about it, and then proceed to make it tight and secure, as has been directed above.

There is another method of burning letters, without grooves, and this is done by boring small holes in the letters, about an inch distance one from the other; the diameter of the holes must not be above the eighth of an inch; into them put, and glue, cases, rammed with burning charges:—these letters do not burn so long as the others, except the charges are very long.

Another method for burning of letters is, when they are formed, by a smith, of coarse wire, about a quarter of an inch thick; when this is done, get some cotton spun into match-thread, but not much twisted; to two yards of this, take one pound of sulphur, six ounces of nitre, and two ounces of antimony; melt these ingredients in a kettle, first the sulphur by itself, and then the rest all together; when melted, put in the match-thread and stir it about, till it has drawn in all the matter; then take it out, and strew it over with mealed powder; let it dry, and wind it about the white letters: fasten these upon a board, that has been well laid over with a preservative to keep it from firing. When you have lighted one letter, all the rest will take fire immediately.

Letters cut through a smooth board, which is made to slide in the grooves of a chest, are ordered thus: the lid of the box is made full of holes, for dispersing the smoke of the lamps, or wax tapers, which are set behind to illuminate the letters; behind the cut-out letters is pasted oil paper, of various colours, which, when the lamps are lighted, has a fine effect. By these means, various changes may be made in representing devices, names, coats of arms, &c. But this way is more practised on the stage, in plays, than in fire-works.

Charges for burning Letters with Cases.

MEALED powder six ounces, nitre one pound, mixed with rock-oil, or petroleum oil.

Mealed powder three quarters of a pound, nitre nine ounces; and sulphur three ounces, mixed up dry.

Mealed powder five ounces, nitre seven ounces, sulphur three ounces, and file-dust half an ounce; moistened with linseed oil.

To order and preserve Leading-fires, Trains, and Quick-matches.

FIRE-WORKS being of various kinds and inventions, it is impossible to assign certain rules for their several performances. But to say something of what concerns a master's praise, it is observed, that great fire-works are not to be fired above once or twice at most; for it would not be deemed an artful performance to fire one cartouch after another; likewise, the match pipes, the most preferable of which are either iron, lead, or wood, and should be strengthened or closely twisted round with the sinews of beasts, and filled with slow charges, which ought to be well tried; or else furnished with match-thread, dry and well prepared, and afterwards either joined to the grooves made in the boards, or only laid free from one work to another. The joinings of the pipes must be well closed and luted with potter's clay, so as to prevent the fire from breaking out; these pipes must also have little vent holes to give the fire air, or else it would be stifled, and burst the pipes; but these holes must be so contrived, that the flame may vent itself in the open air, and at some distance from the works, so as to prevent touching them.

All burning matches are to be as distant from the machines as possible, to prevent accidents.

A particular direction for conducting your trains and fuzees, cannot be given, because of the variety of postures, situations, and contrivances of machinery: those rules already given will be sufficient for the ingenious: add to this, the advantage a novice in this art may gather from the direction in the figures, which, with much care and industry, have been traced out for their information.

Charges for Fuzees, or Leading-matches.

MEALED powder three ounces and a half, nitre four ounces, sulphur one ounce and three quarters, and charcoal one ounce and three quarters.

Mealed powder three ounces, nitre nine ounces, sulphur four ounces and a half, and charcoal half an ounce.

Mealed powder four ounces, charcoal half an ounce, and coarse coal half an ounce.

Mealed powder half a part, nitre three parts, sulphur two parts, and charcoal one part; this last is very slow.

Of Water-balls.

BALLS, in fire-works, are made of different fashions; some are globular, some oval, some conical, some cylindrical, others in the form of a pendant, or drop.

The water-balls are commonly made of knitted cord-bags, or of wood; those made of bags are shaped like ostriches eggs, and are,

1. Filled with their proper charge.

2. The outside is dipped in glue, and wound about with hemp or flax, till it is a quarter of an inch thick with it.

3. This ball is then coated over with cloth, and about the touch-hole is glued over with a piece of leather.

4. The touch-hole is bored with a gimlet, and stopped with a wooden peg.

5. At the bottom of the globe, pierce a small hole through to the composition, in which fasten a small copper-pipe, furnished with a paper report, together with a leaden balance; glue the report fast to the ball; then dip the ball in melted pitch; open the touch-hole, and prime it with a quick-burning charge.

These balls keep a long time under water before they rise; and if a true balance is not observed in the lead, or the ball is overcharged, they will sink to the bottom, and burn out; therefore you must well observe, that when a water-ball, without the balance, is two pounds weight, you must give it four, or four ounces and a half of lead; but, if it weighs one pound and a half, balance it with three, or three ounces and a half.

Water-balls or globes, made of wood, which swim and burn upon the water without any further effect, are of two sorts, viz. single and double; the single ones are made thus: have a hollow globe, turned somewhat oblong, with a vent-hole; fill that with a good and approved charge, but not too close, prime the end with some mealed powder; then glue a stopple in the hole, which must be thrice as thick as the shell of the globe, in which beforehand the counterpoise is cast of lead; when dry, make a hole at top, large enough for a two-ounce cracker to enter; through this, ram down the charge in the globe, and fill it quite full with the same composition; then glue it over with a paste-board: and, lastly, fix a small copper pipe through the stopple, having bored a hole through it for that purpose; to the pipe fasten a paper report; when this is done, dip the whole in pitch: these are called single water-globes. Both sorts of globes are, for better security, twisted and tied round with several rows of strong packthread.

Double water-globes are such, which after one is fired, discharges another. These have chambers at bottom, which are filled with gunpowder; on these put a cover of thick leather, which has several holes in the middle, and goes close to the side; on this strew mealed powder, and place thereon a fire-globe, which is charged. Fig. 52, will demonstrate the construction. Observe,

1. That the little chamber, at bottom, ought to be one-fifth of the breadth of the whole globe, and that its height be one and a half.

2. That the water-ball B should be encompassed with a water-ball composition, as you see by H.

3. The partition C is for this purpose, that when the powder in it shall have the fire conveyed to it through the pipes E F G, it may with more force blow up the ball in the body of the first; this taking fire at the hole D, will burn upon the water for some time, and then, to the astonishment of the spectators, on a sudden, it will blow up the ball that was in it.

4. You must be very careful to secure the piece of leather or board that covers the little chamber, lest it should be blown up by the composition of the greater globe, before it is all burned out.

How to charge a Water-globe with many Crackers.

Take, for this purpose, a single water-globe, which may be round, or of an oval form, and fill the same with the composition hereafter-mentioned. Hollow the outside, in several places, to the size of your reports, or crackers, which are to be fixed in them: to each of the crackers belongs a small copper tube, filled with mealed powder; which is to be fitted to the small holes in the flutings, in the manner as expressed in the print, where fig. 53. A, are the flutings; B, the little holes for the fuzes; C, the upper orifice for priming; D, the hollow stopple, through which the ball is primed; E, the form of the crackers, which are to be fixed in the flutings; F, little fuzees belonging to them.

How to prepare a Water-mortar, or Water-pump, with several Tubes.

TAKE seven wooden tubes; wrap them about with cloth that is either pitched or dipped in glue, twisting them round very tight with packthread. Their height, thickness, and diameter, you may order as you think proper, only allowing the middlemost a greater height than the rest; bind them together in one cylindrical body: to the bottom fix a round board, with nails, and then with strong glue stop up all the crevices to prevent the air getting to the composition: this done, fill the tubes according to the order represented in fig. 54. First pour into each tube a little corn-powder, about half an inch high; upon that put a water-ball A; upon that a slow composition; then again corn-powder, upon which put a water-globe, filled with squibs, as you see in B; on that again a slow composition, then corn-powder; and then a light ball, as may be seen in C; over this put, a third time, a slow composition upon corn-powder, as before, which you must cover with a wooden cap; on this fix running rockets, not too close, but to leave room enough between for a wooden case filled with a water composition; the remainder of the tube fill with a slow charge, and close it up. Your tubes being all filled in this manner, get a square, or round, piece of plank, with a round hole in the middle, large enough to receive the ends of all the tubes, which cover close, to preserve the powder and composition from being wet; this float-board is marked with the letter D, fig. 55. Thus prepared, dip it in a quantity of tar, or melted pitch; then put the rocket E, or a small wooden tube filled with a strong composition that will burn on the water, into the orifice of the middle tube; the composition of which should be more slow than the rest.

If you would have the tubes take fire all round at once, you must pierce the sides of the great one with small holes, corresponding with those in each of the other tubes; by this means the fire may be conveyed to all of them at once, and consume them equally and at one time; but, if you would have them burn one after another, you must close them well up with paste-board; and to each tube fix a fuzee of communication, filled with mealed powder, or a slow composition, through which the fire may be conveyed from the bottom of that which is consumed, to the orifice of that next to it; and so on, successively, to such as have not been fired.

How to charge a large Water-globe with several little ones, and with Crackers.

Get a wooden cylinder made; let its orifice be at least one foot diameter, and its height one and a half: let there be a lodge, or chamber, at bottom, to hold the powder, which must be confined by a tampion, or stopple, joined to a round board, fitted exactly to the inside of the globe; through the middle of the stopple must pass an iron tube filled with mealed powder; then prepare six water-balls, or more, if you think fit, so that when all are set together in the circumference of the globe, they may fill up that circle; each of these balls must be provided with an iron fuzee in its orifice, filled with mealed powder. Having charged the chamber of the globe with corn-powder, let down the fore-mentioned board, with the stopple upon it; then arrange the six water-balls; cover them with another round board, that has six little round holes, corresponding with the six iron fuzees of the balls, which must a little surmount it. Spread this last board over with mealed and corn-powder, mixed together; and upon it place as many rockets as the globe can hold: in the midst of these fix a large rocket, into whose orifice the iron tube may enter, which is the same you see in E, fig. 56.

This tube must have holes drilled all round the plane of the said partition or board, that the fire, having a communication through them, may reach the running rockets, and at the same time fire the water-balls, whose tubes rise out of the board; and, thence, after having penetrated down to the chamber below, may blow up the whole into the air, and make a great noise. See the figure, where A points out the six water-balls; B, the great rocket in the middle of the running ones; C, the chamber for the powder; D, a communication, or the iron pipe, to convey the fire to the paper cracker; F, the globe; which having been adjusted after the manner directed, cover it close round, and dip it in tar, to preserve it from the water.

To prepare the Water Bee-hive, or Bee-swarm, both single and double.

THE single bee-swarm is thus prepared. Have an oblong globe turned, whose length is two diameters of its breadth, or proportioned to the height of your rounding rockets, which place round the wooden tube marked with A; this must be of an equal height with the globe, and be filled with a composition of three parts of powder, two of nitre, and one of sulphur; at the lower end of the globe fix a paper cracker C. The letter D is a counterpoise of lead, through which you convey a little pipe, or fuzee, to communicate with the charge in the wooden tube: at top, fix a round board for a balance, and two little holes, which convey the fire to the charge for blowing up the rockets. See fig. 57.

How

How to prepare a Water-globe, on the Outside, with Running-rockets.

Get a wooden globe perfectly round and hollow; bore on the outside several cavities, sufficient to receive running-rockets, leaving a quarter of an inch between the extremities of them, and the composition within the ball; then bore the wood left between each, with a small gimlet; fill them with mealed powder; then put in your rockets, close the top of the globe with a wooden cylinder, that has a hollow top, with a touch-hole to receive the priming; the bottom stop with a stopple, which likewise has a conveyance to the cracker that is commonly fixed beneath it; between which and the stopple fix also a leaden counterpoise, to keep the whole upright in the water. See fig. 58.

To prepare Water-globes with single or double ascending Rockets.

For the first sort, have a globe turned with a tube in the middle, half its diameter wide, leaving two inches for the placing of solid wood at the bottom; round this tube, bore holes for small rockets; after which, burn, with a red hot wire, or small iron, touch-holes out of the large tubes into the little ones; then fill the globe with the following composition, *viz.*

Two pounds of nitre, eight ounces of sulphur, eight ounces of mealed powder, twelve ounces of saw-dust; this done, close the top with a stopple which has a touch-hole in the middle; then put a good deal of mealed powder into the small tubes, up to the touch-holes; and after you have placed your rockets upon that, fill the vacancy round with a little corn-powder; glue over them paper-caps; then dip the globe into pitch, but not over the paper covering; fix a counterpoise at bottom; and when the fire has burned half way, or further, in the large tube, it will communicate through the touch-holes, and discharge all the rockets at once.

The second sort are made after the same manner, only the middle tube is not bored so wide, because of giving more room for two rows of small tubes round it; the first row, next to the tube, is bored a little below the middle; the second almost near to the end; the touch-holes for the former are burnt from the inside of the great tube, and those of the latter, from the outside hole, are closed again with a wooden pin: in the large tube you may lodge a strong report of iron, charged with corn-powder, having a touch-hole left at top. See fig. 59, 60.

Charges for single Water-globes.

CORN-POWDER half a pound, nitre sixteen pounds, sulphur four pounds, ivory shavings four ounces, saw-dust, boiled in saltpetre-lye, four pounds.

Mealed powder one pound, nitre six pounds, sulphur three pounds, iron filings two pounds, and resin half a pound.

Mealed powder four pounds, nitre twenty-four pounds sulphur twelve pounds, saw-dust eight pounds, powdered glass half a pound, and camphor half a pound.

Corn-powder one ounce, nitre twelve ounces, sulphur four ounces, and saw-dust three ounces.

Nitre twelve ounces, sulphur four ounces, saw-dust two ounces; melted stuff three quarters; this must be rammed in tight.

Mealed powder one pound four ounces, nitre one pound eight ounces, sulphur nine ounces, saw-dust five ounces, pounded glass one ounce, melted stuff four ounces; mix them together with a little linseed oil.

Mealed powder eight ounces, nitre five pounds, sulphur two pounds, copper filings eight ounces and a half, and coarse coal-dust eight ounces and a half.

Nitre eight ounces, sulphur three ounces, saw-dust one ounce, and tanner's-bark two ounces.

Nitre six pounds twelve ounces, sulphur two pounds fourteen ounces, melted stuff half a pound, saw-dust one pound, coarse coal-dust one pound, and pounded glass one pound, mixed up and moistened with vinegar.

Nitre two pounds twelve ounces, sulphur two pounds six ounces, melted stuff four ounces, saw-dust eight ounces, charcoal one ounce and a half, and pounded glass three quarters of an ounce, moistened with linseed oil, and mixed up with a little corn-powder.

Charges for double Water-globes.

NITRE four pound six ounces, sulphur one pound four ounces, saw-dust half a pound, and coarse coal-dust six ounces, moistened with a little vinegar or linseed oil.

Mealed powder one pound four ounces, sulphur four ounces, and charcoal two ounces, moistened with *Petroleum* oil, or rock oil.

Nitre three pounds, sulphur a quarter of a pound, and saw-dust boiled with nitre ten ounces, moistened a little.

Charges for Bee-swarms.

MEALED powder thirteen ounces and a half, nitre six ounces, sulphur two ounces and a half, fine charcoal three ounces, coarse charcoal one ounce, and fine saw-dust three ounces.

Mealed powder three quarters of a pound, nitre six ounces, sulphur three ounces and a half, fine charcoal four ounces, and coarse charcoal two ounces and a half.

Mealed powder four parts, nitre eight parts, sulphur two parts, coarse charcoal two parts, and fine charcoal one part.

Odoriferous, or perfumed Water-balls.

HAVE balls turned, about the size of large walnuts; fill them with any of the compositions specified below; after they are filled and ready, light and put them into water. This is generally done in a large room, or hall, at grand entertainments.

The Compositions for them are as follows:

NITRE four ounces; *storax calamita*, one ounce; frankincense, one ounce; mastich, one ounce; amber half an ounce; civet, half an ounce; saw-dust of juniper, two ounces; saw-dust of cypress, two ounces; and oil of spike, one ounce.

Nitre two ounces, flowers of sulphur one ounce, camphor half an ounce, raspings of yellow amber half an ounce, coal of lime-tree wood one ounce, flowers of benjamin half an ounce; let those which are to be powdered be done very fine; then mix them together, as usual.

Nitre two ounces, myrrh four ounces, frankincense three ounces, amber three ounces, mastich one ounce, camphor half an ounce, resin one ounce, boiled saw-dust one ounce, lime-tree coal, half an ounce, bees-wax half an ounce; mix them up with a little oil of juniper.

Nitre one ounce, myrrh four ounces, frankincense two ounces and a half, amber two ounces, mother of pearl four ounces, melted stuff half an ounce, and resin half an ounce; mix them up with oil of roses.

Mealed powder three ounces, nitre twelve ounces, frankincense one ounce, myrrh half an ounce, and charcoal three ounces, mixed with oil of spike.

The manner of preparing the melted Stuff.

MELT twenty-four pounds of sulphur in a shallow earthen pan, over a clear fire, and as it melts, fling in sixteen pounds of nitre; stir them well together with an iron spatula; as soon as they are melted, take it off the fire, and add to it eight pounds of corn-powder; mix it well together, and, being cooled, pour out this composition upon a polished marble, or metal-plates, and then divide it into pieces about the size of a walnut. This composition is chiefly used in military fire-works, and not for those I am treating of; but for those fire-works which are only for pleasure, it is distinguished by warm and cold melted stuff, and is prepared in the following manner.

Take for the first sort half a pound of nitre, grind among it three quarters of an ounce of antimony, that one cannot be distinguished from the other; then melt one pound and a half of sulphur, put the mixed nitre and antimony to it, and mix them well together; this done, put it warm into a wooden mould of two pieces, which should be well greased on the inside: this stuff you break afterwards into less pieces: it is, on account of its clear fire, used to imitate stars.

The Manner of preparing the cold melted Stuff.

GRIND the above ingredients, or eight ounces of mealed powder, four ounces of nitre, three ounces of sulphur, and one ounce of coal-dust, together, till all is of one colour; this done, moisten that stuff with the white of eggs, gum-water, or size, and make a stiff dough; then strew, on a smooth board, some mealed powder; roll the dough upon that a quarter of an inch thick; strew, again, mealed powder upon it; then cut it in square pieces, and let them dry; or else form small balls of it, of the size of a small nut, or larger; then roll them in mealed powder, and put them up to dry.

To prepare a Globe which burns like a Star, and leaps about both on Land and Water.

CAUSE a globe to be turned, of dry wood, whose diameter is the length of a half pound or a pound rocket: divide this globe into two equal parts; in the middle of one of the half globes, on the inside, make a cavity, deep, long, and wide enough to hold three or four rockets, or crackers, so that the other half of the globe may be easily and closely fitted upon them; after this take three crackers, one with strong reports, and two without any; place them so into the hollow, that the head of the one may lay to the other's neck, and be so ordered that as soon as the one is spent, the other may take fire and force the globe back, and thus alternately from one to the other till it comes to the report, which finishes. Care must be taken that the fire passes not from the first to the next cracker, before it has quite consumed the first, but as I have given a caution in the article about rockets that run on a cord, the same may be observed here.

Having taken care to fix the rockets, cover them with the other half globe, and join them firmly with strong pasted paper.

To charge Globes, which leap on Land, with Iron and Paper Crackers.

TAKE a hollow wooden globe, which has a touch-hole at the top, in the form of a small cylinder; fill it with an aquatic composition, quite full; then bore into the charge five or six holes, about half an inch wide, in which put iron petards, or crackers, which run tapering; provide them at the lower end with a small touch-hole, and cover the top with a tin-plate, in which there is four holes, which you must close up with wads of paper or tow, after you have filled them with the best corn-powder: and when you fire them on even ground, you will see them leap as often as a cracker goes off. See fig. 61.

The other sort is not much unlike the first, except that to this you add a certain number of crackers, which are disposed as you may observe in fig. 62. A the crackers, B the touch-hole.

How the Globes, discharged out of a Mortar, are made and ordered.

First find the mouth of a mortar, and divide it into twelve parts; then have a globe turned of wood, which is two diameters of the mortar's mouth high; divide the diameter in six equal parts, and let the height between A and C be the diameter of the globe; the thickness of the wood H I, should be one-twelfth of the above diameter, and the thickness of the cover of the globe; the height of the priming-chamber F shall be one-sixth and a half of the diameter, but its breadth only one-sixth; the diameter of the touch-hole B is one-fourth, or one-sixth, of that of the chamber: for the better understanding these directions, see fig. 63.

The manner of filling these globes is thus:

Take hollow canes, or common reeds; cut them into lengths, to fit the cavity of the globe, and fill them with a weak composition made of three parts mealed powder, two of coal, and one of sulphur, moistened with a little linseed oil (excepting the lower ends of them, which rest upon the bottom of the globe, which must have mealed powder only, moistened likewise with the same oil, or sprinkled over with brandy, and dried:) the bottom of the globe cover with mealed powder, mixed with an equal quantity of corn-powder; the reed being filled in this manner,

ner, set as many of them upright in the cavity of the globe, as it will contain; then cover it well at top; and wrap it up with a cloth dipped in glue; the priming must be of the same composition with the feeds.

The globes represented at 64, and 65, are contrived like the above, only the first of these is filled with running rockets, and the last with crackers, stars, and sparks, interspersed with mealed powder, and put promiscuously over the crackers. The figures are so plain, that I need not give any further explanation.

No. 66 is the representation of a globe, which plainly shews its construction: the great globe, which contains the lesser, is the same as described above; for it is charged with running rockets. In the midst of these rockets fix a globe in a cylindrical form, with a flat bottom, and a chamber and touch-hole. The cavity of this inner globe is filled with iron crackers, and covered with a flat covering: the priming chamber is to be filled with the same composition as has been directed for the above globes: the fuzees must be filled with good mealed powder.

To prepare the Light Balls, proper to be used at Bonfires.

TAKE two pounds of crude antimony, four pounds of sulphur, four pounds of resin, four pounds of coal, and half a pound of pitch; having powdered all these ingredients, put them into a kettle, or glazed earthen pan, over a coal fire, and let them melt; then throw as much hemp, or flax, into it as may be sufficient to soak it up; then take it off the fire, and whilst it is cooling, form it into balls.

You may wrap them up in tow, and put them either into rockets or globes

To prepare the Paste for Stars and Sparks.

TAKE five ounces and a half of mealed powder, one pound twelve ounces of sulphur. *Or,*

Take three pounds of mealed powder, six pounds of nitre, one pound of sulphur, two pounds of camphor, and two ounces of tanner's-bark, or saw-dust. Moisten all these ingredients with linseed oil.

Take mealed powder one pound, nitre four pounds, sulphur half a pound, and powdered glass six ounces; moistened with a little linseed oil.

Nitre half a pound, sulphur two ounces, antimony one ounce, and mealed powder three ounces.

Nitre half a pound, sulphur three ounces, antimony one ounce, and iron file-dust half an ounce.

Nitre two pounds, mealed powder ten pounds, and sulphur one pound.

Nitre one pound, sulphur half a pound, mealed powder three ounces, and antimony one ounce.

Having mixed and prepared your ingredients, boil some flax in nitre-lye and camphor; then cut it small, and mix it up with any of the above compositions, which must be moistened with either the white of eggs, gum, or size: form this into little balls, of the size of a hazel-nut; strew them over with mealed powder, and let them dry.

To cause the stars to burn very bright, make your composition of one ounce and three quarters of nitre, three quarters of an ounce of sulphur, and a quarter of an ounce of powder.

Nitre two pounds, sulphur fourteen pounds and a half, and mealed powder six ounces.

The paste, or melted stuff above-mentioned, is also made use of for the same purpose, wrapped in tow.

To project Globes from a Mortar, and the Quantity of Powder required for that Purpose.

THE globes being of wood, it is requisite that the charges for them should be agreeable to their substance; for which end they are first weighed, allowing for each pound of its weight a quarter of an ounce of gunpowder. For example, if your globe weighs forty pounds, you must, to discharge it, allow ten ounces of powder.

The charge is thus performed; put the powder into the chamber of the mortar, and cover it with straw, hay, hemp, or flax, so as to fill it quite full; or if the chamber of the mortar be too big, get one turned of wood, equal in height and breadth to the chamber of the mortar that contains the charge of powder required; pierce this with a red hot wire, from the bottom of the wood to the centre of the bottom of the chamber in it, not perpendicular, but slanting. The place where the touch-hole begins must be marked, so that you may turn it to correspond with the touch-hole of the mortar. When you would load your mortar, cover the bottom of the chamber with a little mealed and corn-powder, mixed together; and upon that put the wooden chamber, in which is the powder required to discharge the globe; then fix the touch-hole of the globe, exactly, upon the chamber, wrapping it in hemp, &c. to make it stand upright.

The mortars contrived on purpose for globes are more commodious, and we are more certain in projecting them: these are cast as follows: the length of the mortar with the chamber, without the bottom, is two diameters of the mouth; the bottom is one-fifth thick; the chamber is half the diameter of the mouth long, and a quarter wide; oval at bottom: the sides are an eighth of the diameter of the mouth thick, which is encreased at bottom to a third; the thickness about the chamber is a fourth part.

Some prepare these balls with nitre four pounds, sulphur one pound and a half, powder half a pound, antimony six ounces, and charcoal half an ounce.

Nitre four pounds, sulphur three pounds, camphor a quarter of a pound, and powder half a pound.

A fixed Sun, with a Transparent Face.

To make a sun of the best sort, there should be two rows of cases, as in fig. 67, which will shew a double glory, and make the rays strong and full. The frame, or sun wheel, must be made thus; have a circular flat nave made very strong, twelve inches diameter; to this fix six strong flat spokes, A. B. C. D. E. F. :—on the front of these fix a circular fell, five feet diameter, within which fix another fell, the length of one of the sun cases less in diameter; within this fix a third fell, whose diameter must be less than the second, by the length of one case and one-third. The wheel being made, divide the fells into as many equal parts as you would have cases (namely, from 24 to 44). at each division fix a flat iron staple, which must be made to fit the cases to hold them fast on the wheel: let the staples be so placed, that one row of cases may lie in the middle of the intervals of the other.

In the centre of the block of the sun drive a spindle, on which put a small hexagonal wheel, whose cases must be filled with the same charge as the cases of the sun. Two cases of this wheel must burn at a time; but begin with them on the fells. Having fixed on all the cases, carry pipes of communication from one to the other, as you see in the figure; and from one side of the sun to the wheel in the middle, and thence to the other side of the sun. These leaders will hold the wheel steady while the sun is fixing up, and will also be a sure method of lighting both cases of the wheel together. A sun thus made is called a brilliant sun, because the wood-work is entirely covered with fire from the wheel in the middle, so that there appears nothing but brilliant fire: but, if you would have a *transparent face* in the centre, you must follow this method; take a piece of paste-board of a circular figure, like the sun's face, and cut out the eyes, nose, and mouth, for the sparks of the wheel to appear through; or, instead of this, paint a face on oiled paper, or Persian silk, strained tight over a small hoop: either of the faces are to be supported by three or four pieces of wire, at six inches distance from the centre of the wheel, so that the light may illuminate the face. In a similar way, you may place transparent motto's—"VIVAT REX;" or any other devices, suitable to the day of exhibition. Half pound cases, filled up ten inches with composition, will be a good size for a sun of five feet diameter; but, if larger, the cases must also be proportionably larger.

EXPLANATION OF PLATE IV.

THAT the reader may have some idea of many of the chemical apparatus employed and mentioned in this work, it has been thought expedient to engrave them on one plate, whereby the whole may be seen at one view. It is adviseable, that it be thoroughly committed to memory, which will save the tediousness of a frequent reference, and give a quickness and facility in performing the operations themselves.

Fig. 1. A perpendicular section of a *Cupel* or *Test*: *c* the powdered bones kneaded with water, and firmly pressed into the iron ring, of which a section is seen at *a b*. There is a part at *d* which is hollowed, or dished out, for the reception of the metal to be tested.

Fig. 2. A *Muffel*, in which all articles are placed which are to undergo the operation of a strong fire, free from smoke, such as enamelled work, stained glass, &c.

Fig. 3. An *Ingot-Mould*, into the grooves of which melted metals are poured.

Fig. 4. A *Retort*, made either of glass or earthen-ware, and used in various distillations.

Fig. 5. A *Crucible*.

Fig. 6. An *Iron Cone*, inverted, with a handle and foot, into which metals, and other results of operations, are occasionally directed to be poured.

Fig. 7.

A *Reverberating Furnace.*

a, The ash-hole door.
b, The fire-place door.
c c c, Registers, to regulate the heat.
d, The dome, or reverberatory.
e, The conical funnel.
f, The retort in the furnace.
g, The receiver.
h h, Iron bars to sustain the retort.

Fig. 8. A *Furnace for colouring of Foils,* where the hand is represented in the act of performing the operation. See the article "*Foil-making.*"

Fig. 9. A *long-necked Glass Alembic.*

A, The body of the matrass.
B, The neck of the matrass.
C, The head of the alembic.

Fig. 10. A *Glass Alembic.*

A, The cucurbit.
B, The head.
C, The aperture in the head, with the stopple.
D, The beak.

Fig. 11. A *Bolt-head,* or cap, which is affixed on the upper opening of a still. A still of this kind nearly resembles the reverberating furnace externally, *fig.* 7.—*d,* which is there the dome, may be supposed to be the upper half of the body of the still, the under half lying hid within the cavity of the fire-place; and in lieu of the conical funnel *e*, is substituted the above *bolt-head.* The exact proportions between the opening of the still, and the neck of the bolt-head, are not preserved in the plate, because the furnace would be, by this; too large for the work, or, on the contrary, the bolt-head would be too small.

Fig. 12. A *Melting Furnace*, with its parts, *A. B. C. D. E*, taken from "Cramer's Art of Assaying Metals." We shall be very particular in the account of this furnace, as it is extremely well constructed, and useful.

Form and Dimensions of this Furnace.

The melting furnace is made of iron-plates, the inner surfaces of which are covered with *lute* *. The cavity of it may be formed according to an elliptical mould. 1st, Make a hollow ellipsis, the focusses 12 inches asunder, and the ordinate 5 inches long; cut it off in both its focusses, that it may assume the figure *A*. 2dly, Make in the hollow body, near its lower aperture, four holes, eight lines in diameter, and directly opposite (*c, c*,). 3dly, Fasten two flat iron-rings (*d*,) almost an inch and a half broad, at both the upper and the lower inward edge of this oval cavity; and fill the inside of it with small iron hooks, jutting out about six lines, and three or four inches distant from each other. These, together with the rings just mentioned, serve to fasten the *lute*. Thus will the body of the furnace be made: only you must add at the outside, two iron handles (*e, e*,) to be rivetted on each side of it, that it may be taken hold of and moved. 4thly, Make the cover of the furnace, which may be formed like the part cut off from the ellipsis, see *fig. B.* Let this have an opening (*b*) made in it, four inches high, five inches broad at bottom, and four inches at the top; and adapt to this an iron door, hung on hinges, to shut close, and having at the inside a border fastened to it, answering exactly to the circumference of the door, and as prominent inwardly as the thickness of the *lute* to be applied to it: for the same purpose, let small iron hooks be fastened to the inside of the door, which is intercepted by the said border. And lest this cover should be burnt within by the force of the fire, you must cover the inside of it with *the same lute*; therefore it must be likewise furnished with a ring and iron hooks, as was done to the part *A*. Besides this, you must fasten two iron handles on the outside of this cover (fig. B. *c c*,): then a round hole must be made in the top of it, being three inches in diameter, prolonged into a hollow tube (*d*) almost cylindrical, and a few inches high, upon which an iron funnel may, in case of necessity, be adapted. 5thly, The lining both of the body and cover of the furnace is made of the same materials as before-mentioned. Moreover, you must make for this furnace two moveable bottoms, viz. one to receive the ashes, to admit the air; the other to serve for reductions. The first is made with an iron plate, formed into a hollow cylinder, open at top, and to be shut at bottom with an orbicular iron plate, as with a basis, five inches high, of such a diameter, as that it may receive the inferior orifice of the body of the furnace (fig. *A*) the depth of half an inch, see fig. *C*: therefore, let an iron ring (*c*) half an inch broad, fastened on the inside of the said bottom, the distance of half an inch from its upper border, to support the body of the furnace put into it. Again, let this bottom have a square door, four inches high, and as many inches broad, that may be shut closely, that you may increase or diminish the draught of the air, at pleasure. On the left side of this door, about half the height of the bottom, let a round hole (*d*) be made, one inch and a half in a diameter, to admit the pipe of the bellows when need requires. Next to this, let another bottom part be made of the same matter and figure as the foregoing: let it be likewise of the same diameter, but two inches higher, so as to be seven inches high. Let it likewise have round it a similar iron ring below its upper border, to support the

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* *Lute* will be described at large in the next article.

body of the furnace to be received in it. But let a hole, two or three inches broad, and one inch high (fig. [illegible] *c*,) be cut out just below the ring in the side of this bottom part; and let another round hole be made in the left side of this first hole, fit to admit the pipe of the bellows (*d*). Further, let another round hole like the foregoing (*e*) be made on the right, one inch from the bottom: then let the whole inside of this bottom part (the part above the ring excepted) be over-laid with *lute*, and a bed be made at the bottom, of a figure like that represented by the line (*f*, *g*, *h*,). The matter of which this is made is common lute pulverized, passed through a sieve, and mixed with such a quantity of sifted charcoal dust, as may be lightly coherent, when moistened, mixed together, and pressed down. Of this matter the bed is made at bottom, like a segment of a sphere, having in the middle a small cavity somewhat lower, and made extremely smooth.

Use of this Furnace.

THIS furnace is chiefly fit for fusions, which may be made in it, with or without vessels. When you are to melt *with a vessel*, put the body of the furnace (fig. *A*.) upon the first bottom (fig. *C*,) which has a door to it, to open on hinges: introduce two iron bars through the holes of the furnace, (fig. *A*. *e*, *e*,); put upon them the iron-grate, which you are to introduce through the upper mouth of the furnace: then put in the middle of this grate a *brick* or square *tile*, very smooth, warmed, and dry; otherwise, the vessels put upon it, especially the large ones, are easily split by the moist vapours coming out of it by the heat. Let the height and width of these be a small matter broader and higher than the bottom of the crucible or vessel set upon it; for if it were less high, the bottom of the vessel could not be sufficiently warmed; and if it were less broad, the vessel might easily fall from it: then put upon this *tile* the vessel containing the matter to be melted, and surround it immediately with coals on every side, which must be ranged with care. The fire is governed and regulated by opening or shutting the door of the ash-hole (fig. *C. b*); you may excite it by putting the cover (fig. *B)* upon the body of the furnace; and if, besides, you put a funnel upon the cylindrical mouth (*d*) of this cover, the melting fire becomes still more violent: but if you moreover introduce the bellows through the hole of the bottom part (*fig. C. d*); and the joint of the furnace with the bottom part and the door of the ash-hole (unless it can be stopped very close of itself) be tightly closed with *Windsor loam*, the fire may be excited to so powerful a degree, as to surpass the heat of a smith's forge. Another advantage of this method is, that the vessels are not so easily broken, because the blowing of the bellows cannot affect them immediately, and because a fire perfectly equal is excited on every side. One may easily examine with this *apparatus*, how *stones* are affected by the violence of the fire only. Now, if you have a mind to perform any operation *without a vessel*, and with a naked fire; for instance, to melt and reduce *copper*, *tin*, *lead*, and *iron*, or their ores; the body of the furnace must be put upon the other pedistals, having a bed in it (fig. *D*). However, you must, before this, open with a knife the oblong hole (*c*), and the round one (*d*) of this bottom part, which are stopped with the lute sticking to the inside: then you apply at the round hole (*d*), on the left side, the bellows, in such manner that the nozzle of it being directed obliquely downwards, may blow strongly against the bed (*f*, *g*, *h*,); by this means, all the ashes that fall into the bed are blown away, and the strength of the fire determined to such a degree, that all the melted bodies that fall into the said bed, remain in their state of fusion; and were it otherwise, the melted bodies would immediately wax cold, and adhere in grains to the bed, whereas they ought to have melted into one regular mass. The oblong hole in the fore part of this bottom part (c) serves to discover, by means of a poker, whether the matter in the bed be melted or not: it serves likewise to take away through it whatever might stop the bellows, and in some cases to take away the *scoria*: then you put, first, coals into the furnace, one span high, and blow them well with the bellows, to make them burn, that the bed may be very hot before the matter to be melted is put in; for if this is not previously done, the melted mass seldom runs into a *regulus*, but remains dispersed among the *scoria*, which soon grow hard. The bed being well heated, and fresh coals added to the fire, put into it such quantity of the matter to be melted as cannot hinder the fire from being carried to the requisite degree; which cannot be determined otherwise than by experience: again, put fresh coals, and upon them another quantity of the matter to be melted; they may be, like *strata*, one upon another: but if the mass, once melted, could not long sustain the strength of the fire, or if you had a mind to melt a greater quantity of the matter than what can be contained in the bed, you must open the round lower hole (fig. *D*, *e*,) that you may make a channel passing from that hole through the lute, and reaching to the small cavity at the bottom of the bed (*g*): to this hole, at the outside, apply an earthen dish like the bed within, or any other proper recipient, surrounded with burning coals, into which the matter melted, running from the bed through the hole (fig. *D*. *e*) may be collected, as is represented by *figure E*.

OBSERVATION.

FURNACES of the foregoing description, together with crucibles, black-lead pots, and many other chemical apparatus, were formerly imported from Germany, at great

cost

and trouble. They are now made in England [*], with considerable advantages, being more portable, cheaper, and readier. A complete furnace, capable of being worked in a parlour chimney, may be had, from £. 3, to a higher expence, which will create little trouble, and will require no assistance from the bricklayer.

OF LUTES.

IN many chemical operations, the vessels must be covered with something to preserve them from the violence of the fire, from being broken or melted, and also to close exactly their joinings to each other, to retain the substances which they contain when they are volatile and reduced to vapour. For this purpose, several matters are employed, called in general *lutes*.

The lute with which glass and earthen-ware retorts are covered, ought to be composed of nearly equal parts of coarse sand and refractory clay. These matters are to be well mixed with water and a little hair, so as to form a liquid paste, with which vessels are to be covered, layer upon layer, till it is of the required thickness. The sand mixed with the clay is necessary in this lute, to prevent the cracks which are occasioned by the contracting of clay during its drying, which it always does when it is pure. The hair serves also to bind the parts of the lute, and to keep it applied to the vessel; for, notwithstanding the sand is introduced into it, some cracks are always formed, which would be likely to tumble off in pieces.

The lutes with which the joinings of vessels are closed, are of different kinds, according to the nature of the operations to be made, and of the substances to be distilled in

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[*] They may be had, of all sizes and prices, of Mess. Pugh and Speck, at their manufactory, at the bottom of Booth Street, Spital Fields.

these vessels. When vapours of watery liquors, and s
as are not corrosive, are to be contained, it is suffici
surround the joining of the receiver to the nose o
alembic, or of the retort, with slips of paper or,
covered with a tough paste of flour and water. In such cases also, slips of wet bladder, which will affix themselves close to the parts, are highly convenient. When more penetrating and dissolving vapours are to be contained, a lute is to be employed of quick lime slaked by the air, and beat into a liquid paste with whites of eggs. This paste is to be spread on linen slips, which are to be applied exactly to the joining of the vessels. This lute is convenient, it easily dries, becomes solid, and sufficiently firm. Lastly, when saline, acid, and corrosive vapours are to be contained, we must then have recourse to the lute called *fat lute*. This lute is made by forming into a paste some dried clay finely powdered, sifted through a fine lawn sieve, and moistened with water, and then by beating this paste well in a mortar with boiled linseed oil, *i. e.* linseed oil which has been made *drying* by boiling it with litharge sold by the colourmen. This lute will take and retain the form that is given it. It is generally rolled in cylinders of a convenient size. These are to be applied, by flattening them, to the joinings of the vessels, which ought to be perfectly dry, because the least moisture would prevent the lute from adhering. When the joinings are well closed with this fat lute, the whole is to be covered with slips of linen, spread with lute of lime and whites of eggs. These slips are to be bound round with pack-thread. The second lute is necessary to keep on the fat lute, because this latter remains soft, and does not become solid enough to stick on alone.

PART

PART II.

A VARIETY OF

CURIOUS AND VALUABLE EXPERIMENTS

ON

GOLD AND SILVER;

SHOWING THE METHOD OF TESTING, REFINING, SEPARATING, ALLOYING, AND TOUGHENING THOSE METALS; TOGETHER WITH OTHER RECEIPTS, FOR GILDING, &c.

PREVIOUS to entering upon the several detached receipts upon gold and silver, it may be proper to give a brief sketch of metallurgy, or, in other words, "The art of extracting and purifying of metals, in the great way."

After trial has been made on a small scale (which is called an Assay) that any particular mine is likely to be profitable, the workmen proceed as follows: They dig a perpendicular square pit, large enough to admit ladders, whereby they may descend. Across the mouth of this pit, which is called a shaft, an axis is usually laid, for the purpose of raising buckets loaded with the mineral; and pumps are also placed, for carrying off the drainage water. If the depth of the mine be so great as to exceed the due proportion of the first square pit, an horizontal drift is formed, at the end of which a new shaft is sunk, and so on alternately till they reach the bottom of the ore-mine. The drifts, which resemble galleries in some measure, are propped up by art, if the stratum through which they pass is of too crumbly a texture to support itself. Regular supplies of fresh air ought at all times to be kept up. Sometimes it is practicable to open an immediate passage to the plane below; but if this cannot be effected, a new shaft is sunk at that part of the drift or gallery which is furthest from the former shaft, so that if one of these is higher than the other, the air easily circulates. When, however, they are equally high, a fire is kindled in a furnace over the mouth of one of the shafts, and thus a supply of air is gained. Again, the pumps which are usually employed to take off the drainage water are sometimes insufficient for the purpose, for a sudden burst of water will in a moment inundate the galleries; in that case, the workmen, having warning by the peculiar sound of the rock when it is struck, cut the rock to give vent to the water, and retreat behind a door which they have prepared, which shuts out the fluid from overtaking them.—Mines are subject to elastic vapours, which are extremely dangerous to the workmen: their effects are prevented by rapid currents of fresh air, or by detonation.

When the mineral is brought out of the mine, it is pounded, washed, roasted, melted and refined. For pounding it, large knockers are moved by some strong mechanical power; and after it is pounded, it is put on inclined tables, to be washed, that the water may carry off the gangue, matrix, or immediate bed of the ore. When ores contain sulphur they should be roasted in the open air, otherwise they may be roasted in the furnaces in which they are to be afterwards melted. Some ores will melt by themselves; others require a flux for fusing them, and must be brought in contact with charcoal. The furnaces which are employed are of various kinds; but, sometimes, the same furnace will answer two purposes. Although metals are by these means reduced to a metallic state, yet they are frequently mixed together, of various kinds, and they therefore require some further processes to separate them.

OF GOLD.

GOLD, which has been termed *sol*, the *sun*, and *king* of metals, is a perfect metal, of a splendid yellow colour, and not liable to alteration. When gold is very pure it loses in water between a nineteenth and a twentieth of its weight. A cubic foot of gold weighs 1326 pounds: its hardness is not very considerable, being in an intermediate state between the hard and soft metals. It is extremely malleable, and spreads readily under the hammer; and by the hand of a skilful artist may be wrought into any shape or form. So wonderful and surprising is its ductility as to nearly exceed belief. From absolute experiments, an ounce of gold may be beaten into a leaf that will cover ten acres of ground; and an ounce of gold may be made also to cover, perfectly, a silver wire that is 444 leagues, or 1332 miles, or 2,344,320 yards, or 7,032,960 feet, or 84,395,520 inches, in length. A single grain of pure gold has been extended over an area that is more than fourteen hundred inches square; and a wire of the same metal, only one-tenth of an inch in diameter, has been found so tenacious as to support five hundred pounds weight, without breaking. Long hammering will make it rather brittle, but heat soon restores its ductility, which is termed nealing or annealing. The colour of gold sometimes varies, but this is owing to some mixture or alloy. When it is pure it is called gold of 24 carats; and as the number of carats decrease, so much the more is the alloy (generally of silver or copper); thus, one quarter of silver, and one quarter of copper, to one half of gold, incorporated together,

gether, make a gold of 12 carats; and this is specified on the bars or ingots. Gold is unalterable by air or water, and the dulness, which may appear occasionally on its surface is entirely owing to extraneous matters, and not to rust. The action even of fire, long continued, makes no alteration of its substance. When it has acquired a vivid redness, it soon melts, but it emits no fumes, and suffers no loss of weight whilst in fusion. Kunckel kept gold in a glass-house furnace for a month; and Mr. Boyle kept it in a similar furnace for a much longer time, without the loss of a single grain. Simple chemical agents are unable to make any impression on gold; but compound bodies, such as aqua regia and liver of sulphur[*], dissolve it powerfully. Gold has a much greater affinity for mercury than any other metallic substance has, and it will therefore decompose amalgams of any other metals with mercury. The amalgam of gold with mercury is of a higher and more solid colour in proportion to the greater quantity of gold. This amalgam is liquified by heat, and will crystallize on cooling, like most of the compounds of this kind. It is used principally by the workmen in gilding in *water-gold*, termed *water-gilders*. An alloy of silver with gold produces *green gold*, which is used by the jewellers.

As gold is a standard fixed by most nations, to represent the value of the productions of nature and art, it is highly necessary and important to discover its extreme purity, and to be able to detect any fraud which may have been used to encrease its bulk. Chemists are in the possession of a method of *testing* it, and this peculiar process is termed *cupellation*, which is as follows.

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[*] These old names are retained, in lieu of *nitro-muriatic acid* and *sulphuret of potash* of the new nomenclature, because they are sold by these names in the shops, and are so called by the workmen in gold and silver. *Ed.*

Method.

Method of testing Gold by Cupellation: used also in testing of Silver.

The process of cupellation is the art of destroying, vitrifying and scorifying all the imperfect metals which are destructible, and which are extraneous to pure gold and silver. We see then, that the examination, or *assay*, of the purity of gold or silver, separately considered (for when they are mixed, and purified from their several ores, on a large scale, it is termed *refining*) is no other than ascertaining the difference of weight between the residue of the metal, after the operation, and its primitive state. A quantity of lead, proportionate to the supposed quantity of alloy, is mixed with either of the purer metals. This mixture is put into flat porous vessels, called *cupels*, made of the powder of calcined bones kneaded with water; or the latter composition is crammed into an iron ringle, see plate iv. fig. 1. After this, it is exposed, for a length of time, to the strongest heat of a reverberating furnace, till the imperfect metal, lead, is totally scorified, or, till the gold, or silver, which ever is the subject of the operation, assume a dazzling brightness. At this time it will be found, that the bone ashes have absorbed the impurities, and the pure metal forms a bright metallic button in the centre of the cupel. In determining the quantity of impurity the purer metal contained, it is considered as consisting of *twelve* parts, which are called *penny-weights*, each of which are divided into twenty-four grains. If the mass under consideration has lost in the cupel only the twelfth-part of its weight, it is said to be of *eleven penny-weights*; if it has lost only a twenty-fourth part of its weight, it is said to be of *eleven penny-weights and twelve grains* fine

Of separating Gold from Silver.

ALTHOUGH gold and silver may be perfectly separated from the more imperfect metals by the afore-mentioned process, yet they cannot be separated from each other by the same means, because they equally withstand the heat of the furnace: other methods, therefore, are employed, which are termed *parting*, viz. by *solution*, by *cementation*, and in *the dry way*; of which, separately.

Parting of Gold from Silver, by Solution.

PARTING by solution is usually termed *parting by aqua fortis*. The aqua fortis, which is used for this purpose, must be extremely pure, and free from any admixture of other acids, otherwise the other acids will keep a part of the silver dissolved within themselves, forming other compounds, which remaining mingled with the gold, will keep some of the silver unpurified by the process. Another material circumstance, beside the purity of the aqua fortis, is, a due knowledge of the proportions of the two metals to each other, for if the gold exceed the silver in quantity, the latter will be covered by the former, and thus be guarded from the action of the acid, which, it should be observed, is not a solvent of gold. When assayers, therefore, want to know the proportion of gold to silver in the mass, they rub the mass upon a touch-stone, so as to leave a mark upon it; they then make similar marks with their *proof needles* (which are needles composed of gold and silver allayed together in graduated proportions), and by comparing the colour of the several marks, they discover the probable scale of admixture. Having ascertained this point, they add more silver, if necessary, and the mixed metal is either rolled up spirally into *cornets*, or is reduced into grains, and is placed in a matrass (See plate 4.); the aqua fortis is now to be poured upon it, in the proportion, by weight, of three parts to two of the *silver*, and the solution is to be assisted by the heat of a sand-bath. When no further solution goes on, the aqua fortis is thoroughly charged with the silver, and is to be decanted off; fresh aqua fortis is to be added, and to be repeated to a third time, as before: the gold is now to be washed with boiling water, which will make it perfectly pure, if the operation has been duly performed, and this gold is called *gold of parting*.

Parting of Gold from Silver, by Cementation.

Parting *by cementation*, which is an appropriate term, is also called parting by concentration, and is usually employed when the quantity of gold is so great to that of the silver, as to render it a difficult task by aqua fortis. The mixed metal to be cemented is to be reduced to plates, as thin as small pieces of money. At the bottom of the crucible, or melting pot, is to be laid a stratum of cement, composed of four parts of bricks powdered and sifted, one part of green vitriol, *i. e.* copperas, calcined to redness, and one part of common salt; about the thickness of a finger in depth. Upon this stratum a layer of plates of the metal is to be placed, and then another stratum of cement, and so on till the crucible is filled. It is now to be placed in a furnace, or oven, (after a top has been luted on the crucible) and exposed for twenty-four hours, till it is gradually made red hot, but by no means to be melted. The fire is now left to go out, and the metal is permitted to cool, that it may be separated from the cement, and boiled repeatedly in large quantities of pure water. This gold is afterwards to be tried on a touch-stone; and if it is not sufficiently purified, the process must be formed a second time.

By the above method we see how powerfully silver is dissolved by marine acid, when in a state of subtile vapour, which is disengaged from the common salt of the cement. Instead of common salt, nitre may be used, as the nitrous acid readily dissolves silver; but the mixing of common salt and nitre together, is highly injudicious, because the joint acids are able to dissolve some of the gold with the silver. Whatever silver has been separated will now remain in the cement, but it may be freed from this by lead, in the method described in *cupellation*.

Parting of Gold from Silver, in the dry Way.

BESIDES the two former methods of parting, there is a third, which is termed *dry parting*, or parting by fusion, which is performed by means of sulphur. This dry parting is troublesome, and even expensive, and ought not to be undertaken but when the silver far exceeds the gold, because sulphur will not separate it so easily as aqua fortis, and will, therefore, require a further application to cupellation and solution.

Before we treat of silver separately, we shall mention the purification of gold by antimony.

Purification of Gold by Antimony.

GOLD is purified from its allays by melting it in a crucible that will hold twice its quantity at least, and throwing upon it, whilst in fusion, twice its weight of crude antimony. The crucible is then to be covered, and the whole is to be kept in a melting state for some minutes; and when the surface sparkles, it is quickly to be poured into an inverted cone (see plate 4.) which has been previously heated and greased. By striking the cone on the ground, the descent of the metal will be assisted, and will come out, compactly, when cold, by simply inverting it. The compact mass consists of two substances: the upper part is the sulphur of the crude antimony united with the impure allay; and the lower part is the gold united to some of the regulus of antimony, proportionable to the quantity of metals which have been separated from the gold, and which are now united with the sulphur of the antimony. This regulus of gold may be separated from the regulus of antimony by simple exposure to a less heat than will melt the gold, because antimony is volatile in such a heat, and is then dissipated. If the gold is not sufficiently purified by this first process, (which is often the case) it must be repeated a second and even a third time. When a part is dissipated, more heat is required to keep the gold in fusion; therefore the fire must be encreased towards the end of the operation. The purification is completed by means of a little nitre thrown into the crucible, which effectually calcines the remaining regulus of antimony. Sometimes after these operations, the gold is found to be deprived of much of its usual ductility, which, however, is easily restored to it by fusing it with nitre and borax.

OF SILVER.

SILVER, called *Luna* and *Diana*, by the chemists, is a metal of a white colour, and lively brilliancy. It has neither taste nor smell, when perfectly pure. Its specific gravity is, although considerable, nearly one half less than that of gold, as it loses in the hydrostatic balance about an eleventh part of its weight. A cubic foot of this metal weighs seven hundred and twenty pounds. The tenacity of silver is also very considerable, for a wire of this metal, only one-tenth of an inch in diameter, will sustain a weight of two hundred and seventy pounds, without breaking. Although gold exceed it in ductility, yet it may be drawn into wires as fine as hair, and extended into very thin leaves; so thin, that a grain only may be spread under the hammer, and made to contain an ounce of water. It is inferior even to copper in hardness and elasticity, and next after it the most sonorous. Under the hammer it acquires a hardness, which it may be deprived of by heating. It seems to be as fixed and indestructible as gold. Kunckel kept silver, as well as gold, in a glass-house furnace during a month, without alteration. Silver is apt to tarnish, and even to turn black, but it does not lose its property of being brightened to brilliancy. All the stronger acids are capable of dissolving it, but the muriatic and vitriolic are less powerful than the nitric, or aqua fortis.

Silver may be purified from an allay with other inferior metals, by treating it with lead and also with nitre; the former of which methods is termed cupellation or refining, and the latter *purification by nitre*. As we have given a description of the one, under the article *gold*, we shall now proceed to treat briefly of the other.

Purification of Silver by Nitre.

Silver that is to be purified by nitre ought first to be granulated,* and then mixed with a fourth part of its weight of dry nitre, an eighth part of potash, and a little common glass, all in powder. This mixture is to be put into a good crucible, of such a size as to be only two-thirds filled with it; and it is then to be covered with a small inverted crucible, with a small hole in the bottom, and luted on fast. Several, thus disposed, may be placed in a furnace, to which a ready access of air can be admitted, in order to melt the silver. Charcoal is now to surround the crucibles even with the tops, but not above them; and the fire is to be kindled, and the vessel made moderately red, a lighted coal being placed over the little hole of the inverted crucible. If a shining light be observed round this hole, and a slight hissing noise be heard, the operation proceeds well. Let the fire be kept up equally till the appearance cease, when it is to be encreased to melt the metal thoroughly, and then removed from the furnace. The larger crucible is to be broken when it is cold, and the silver will be found at the bottom, covered with a green alkaline scoria. If the metal be not sufficiently pure and ductile, the operation must be again repeated. Some silver is apt to be lost in this operation, by the swelling and detonation of the nitre, which often forces it through the hole in the upper crucible, unless great care be used; nevertheless, this method has its advantages, being much more expeditious than cupellation.

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* Granulation is easily performed, by pouring, leisurely, the melted metal between the twigs of a new birch-broom, whilst they are agitated, in a pan of water.

We now proceed to detail some of the various methods that are known and practised by workmen in gold and silver.

To prepare a Crucible, so as not to contract any Gold though it be for several Hours in the greatest Heat.

TAKE a good crucible, that will stand the fire, warm it a little, and smear or rub it over with a rhind of Bacon, both inside and outside; then put it in a warm place to dry, when dry, repeat rubbing it over again as before, and let it dry: this do for three or four times. This done, warm your crucible again, and smear it, both out and inside, plentifully, with soap; then put it to dry; and before you use it, put it on a charcoal fire, and the soap will burn in a flame, when it is burnt out, you may use it for melting gold or silver, and it will not attract these metals, as your common crucible will.

Other Receipts for Cements.

Take fine brick-dust one part, and finely pounded salt, one part, moisten and mix them with vinegar, and fill a crucible half full; then stratify plates of gold, or gold coin, with the aforesaid mixture, or paste, and press it close down; repeat this as you have occasion, and put a thick layer at top; then cover and lute the crucible close, that nothing may evaporate: when this is done, fix your crucible upon a high brick, in the middle of the furnace; give it a violent heat, for twelve hours, and the salt will consume the impurities of the gold, and attract it into the brick-dust. *Or*,

Take, in weight, of nitre, of alum, and of sal-ammoniac, one part; two parts of vitriol; four parts of salt; either parts of brick-dust, and mix them with vinegar, stratify this mixture and the gold, as before directed, in the crucible; cover and lute it well, and give it a violent fire for an hour or two, and let it cool of itself; but before it is quite cold, take out the gold, fling it into white-wine vinegar, and boil it therein; then brush it; and after you have done this, heat it red hot upon an iron plate. *Or*,

Take blood-stone two ounces, rust of iron, calcined vitriol, sal-ammoniac, verdigrise, one ounce of each; armenian bole, tutty, nitre, alum, a quarter of an ounce of each, moisten this mixture three or four times with vinegar; let it dry between whiles; then grind it fine, and proceed as directed; give it a strong fire for three hours, and repeat it three times.

To bring the silver out of the cementing powder, or brick-dust, mix it with glass and granulated lead; let it melt together; put it to the test, that is, test it by cupellation, and you will have the silver again which was in the gold.

To separate Gold and Silver out of the Sweepings.

TAKE sweepings; put them into a pan well glazed; add a proportionable quantity of mercury to them; mix the dust and mercury, with your hands, well together, till you think the mercury has extracted all the gold and silver from the dust; then put the mass into a piece of wash-leather, and wring out the mercury; what remains in the leather will be like a paste; put that into an alembic, and drive the mercury from it into a dish with water, which put under the head to receive it; what remains, put to the test; refine it with lead, and separate it with *aqua fortis*.

To separate the Gold from gilt Copper.

TAKE four ounces of sulphur, two ounces of sal-ammoniac, one ounce of nitre, half an ounce of borax; grind them fine, with strong vinegar, to a paste, which lay thin over the gilded copper; give it a gentle heat, until the paste is burned away, and the copper looks black; then take it out, and with a knife, or other such instrument, scrape off the gold in a clean dish, and it will come off very easy.

Another Method.

TAKE the root of *bertram*,* cut it fine; pour one quart of strong white-wine vinegar upon it; put it into a boiling-pot; cover it with a lid; lute it well, and let it boil a little; then take it off the fire, and let it cool. After this, take a copper cup, or any other thing, that is gilt; neal it well; quench it in that liquid, and the gold will fall off from the copper to the bottom, wash it, and then melt it in a crucible. *Or*,

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* Not a commonly known root. *Ed.*

Take fine sal-ammoniac two parts, and sulphur one part; grind them well together, anoint with linseed oil; strew the powder upon it; hold the gilt piece to the fire, over an earthen dish, with water; strike it with an iron, and the gold will fall off into the dish. *Or*,

Take nitre and borax, one ounce of each; dissolve them in a little quantity of water; then neal your copper, and quench it in this water, repeat this several times, and the gold will fall to the bottom.

To separate Copper from Silver, or any other Allay.

Take half an ounce of verditer, or *Spanish green*, white vitriol and sulphur, one ounce of each; alum half an ounce; boil all together in vinegar, in a glass; put in your mixt silver; this will dissolve and extract the copper, and the silver remain whole.

To extract the Silver out of a Ring that is thick gilded, so as the Gold may remain intire: a curious Secret.

Take a silver ring that is thick gilt; make a little hole through the gold into the silver, then put the ring into *aqua fortis* in a warm place; it will dissolve the silver, and the gold will remain whole.

To make brittle Gold malleable.

Put gold into a crucible, and give it a brisk fire in a wind furnace; or before the bellows; when the gold is ready to melt, fling gently upon it some good, dry, and clear nitre, which will presently flame, and promote the fusion of the gold, and will spread and cover the gold;

then cast it into an ingot, which before has been warmed and anointed with wax. *Or*,

A good way to make gold malleable, is this: take human excrements, dry and calcine them in a crucible to a black powder; when the gold is in fusion, fling some of this powder upon it, and give it a brisk fire, when the powder is consumed, cast the gold into an ingot, and it will be fine and malleable: if you extract the salt from the black powder before you use it, it will still have a better effect, and that with a less quantity.

To make Silver that is brittle, pliable.

TAKE a mark of silver, half an ounce of glass, one ounce of nitre, a quarter of an ounce of borax, half an ounce of *sal gemmæ*, or rock salt; put all this into a crucible, and cover it with a lesser one that has a vent-hole at the bottom, and lute it well; then give it a brisk fire, and continue it till you think the silver is dissolved; then cover the crucible all over with live coals, except the vent-hole, and leave it to cool: take off the upper crucible, and you will find therein hanging all the impurities the silver contained, and which occasioned its hardness: then melt the silver again in a crucible, and throw into it half an ounce of tartar finely ground, and, when in fusion, cast it into an ingot, and you will have fine and malleable silver.

To give Gold, Silver, or other Metals, a quick fusion.

TAKE calcined *Venetian* soap, borax, glass-gall, or *Venice* glass, an equal quantity; grind and mix it well together, this will cause a quick fusion. *Or*,

TAKE yellow amber, borax, glass-gall and soap, equal quantities, grind them together to a powder; and what you design to melt, let be done with that composition.

To try whether granulated Silver contains any Gold.

TAKE some silver grains, and make strokes with them on a touch-stone; then, with the end of a feather, let fall a drop or two of *aqua fortis* upon the strokes, and let them continue upon it for a little while; if it contains gold, you will see some remains of the strokes, but if not, the strokes will vanish.

To amalgamate Gold, or to mix it with Mercury, which is of use to Gilders.

TAKE a pennyweight of fine gold, beat it into very thin small plates, heat them in a crucible red hot, then take it from the fire, and pour upon them eight pennyweight of pure quicksilver; stir the matter with a little iron rod, and when you see it begin to rise in fumes, which quickly happens, cast your mixture into an earthen pan filled with water, it will coagulate, and become tractable, wash it several times to take away its blackness, then you have an *amalgame*, from which separate that mercury which is not united, by pressing it between your fingers, after you have wrapt it up in a linen cloth.

Gilding upon Silver, Brass, Copper, and Iron

IF you would gild over silver, take of the above *amalgam*, and with it rub that which you design to gild, close every where, that it may receive gold all over, then hold it over a charcoal fire, or lay it upon it, and it will cause the quicksilver to fly away; after which, you may heighten the colour with gilding wax, as shall be directed.

A par-

A particular Secret to gild Silver to the greatest Perfection.

TAKE *crocus veneris** and vinegar, add to them quicksilver, heat them together, till they come to the consistence of a paste; with this quicken or anoint the silver you intend to gild, and wherever you quicken, it will turn of a reddish gold colour, which doth not happen when done with quicksilver only, for then it looks white: this is a curious secret; you may gild upon this paste with leaf-gold, which otherwise would require to be ground; it makes the [illegible] rich, and of an high colour.

[illegible] curious Manner of gilding on Silver.

[illegible] tartar one part, salt two parts; pour water upon [illegible] add some steel filings: boil the silver therein [illegible] becomes reddish, and it will require only the third [illegible] gold you would otherwise use.

Method of Gilding, which may be done in a Moment, better than with Quicksilver.

TAKE the finest gold; dissolve it in *aqua regia* †, which has been prepared with salt, let the *aqua regia* be evapo-

rated

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[*] Take chips of copper, and quench them in urine; repeat this until it easily pulverizes. The powder you will find at the bottom of the vessel, which workmen term *Crocus Veneris*.

[†] *Aqua regia* is a mixture of the nitric and muriatic acids. The proportions vary, according to the nature of the work it is to be employed in: some make it of equal parts, whilst others double one or other of the acids, as experience in working has directed them. — Aqua regia may be also made by dissolving in nitrous acid any salt which contains the muriatic acid, viz. common salt, and sal ammoniac. It must be kept in a phial closely ſtopped, to keep in the suffocating fumes which are constantly rising.

rated to half the quantity; then put the glass into a damp cellar, on sand, and the gold will over night shoot into crystals, which take out, and let them dissolve again in distilled vinegar, put it again upon the fire, and let the half thereof evaporate, then put the glass again in the cellar, as before, in moist sand, and over night the gold will shoot into crystals. Dissolve these in rain water; and evaporate that to half the quantity, and again it will shoot into crystals, when this is done, take the crystaline gold, grind it to powder with a knife, put that powder into the white of an hard-boiled egg, after the yolk has been taken out; set it in a cool and damp place, and over night it will dissolve into an oil. and what silver you anoint with it, though ever so thin, drying it gently, you will find the gilding of a perfectly high and fine colour.

Gilding after the Grecian *Manner.*

TAKE mercury-sublimate* and sal-ammoniac, of each one ounce; make a solution thereof in *aqua fortis*, then dissolve in it fine gold, beaten very thin; let this solution evaporate over a fire until it becomes thickish; dip in it a silver wire, and if it comes out black, and, by heating it in the fire, turns out gilded, it is fit to be used for gilding silver.

The true Italian *gilding.*

TAKE common vitriol four ounces, alum two ounces, white vitriol one ounce, white lead one ounce, salt two handfuls, river water one quart; let it boil to half the quantity, and let it stand until it settles and looks clear, then it is fit for use.

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* Mercury sublimate, or corrosive sublimate, is mercury dissolved by the muriatic acid; and, by fire, raised to the top of a matrass, or other vessel.

To

To deaden Quicksilver for Gilding.

TAKE pure quicksilver, *i. e.* free from any mixture of lead; put it into a matrass, and fling into it a handful of fine white salt; shake it well together, and let it stand for two days; then pour upon it strong vinegar, let it rest a day, and you will find a good quicksilver for gilding, and very cheap.

To boil Silver white.

FIRST neal your silver on a charcoal fire, till it becomes a little reddish: then, having boiled it with an equal quantity of salt and tartar, powdered, with water, for a quarter of an hour, take it out and scratch-brush it in clean water, then take good tartar, tie it up close in a paper, put it in the fire so long until it has done burning and smoking; grind it to a fine powder, mix it with clean water into a paste, and with it rub over your silver: this done, neal it again, and quench it in cold water: brush what remains black upon it with a hair brush; and boil it for two minutes in tartar water; then rince in clean water, and, after you have wiped it with a dry rag, your work will be done.

A Gold Powder.

TAKE leaf-gold, or any other thin beaten gold, to the quantity of a penny-weight, or as much as you please, dissolve it in twice its weight of *aqua regia.* Let half the solution evaporate in a sand heat; then take dried linen rags, soak them in the remaining liquid, dry them by a gentle heat; and burn them on a slow fire, in a crucible; the powder will remain at the bottom, and be of a yellowish colour, and with this the gilding is performed.

Another

Another for Cold Gilding.

Take half a pound of *aqua fortis*, put into it two ounces of sal-ammoniac, finely pulverized; let it dissolve over a fire, and then filtrate it through a paper; put it into a matrass, with as much fine beaten gold as will weigh two penny-weights; set it on a slow fire, in order to dissolve the gold into this *aqua regia*. When this is done, add to it two ounces of powdered *sal-gemmæ*, or rock salt, fine and clean, and let it dissolve upon the fire; then take fine clean linen rags, each about a quarter of an ounce in weight; dip them into that liquid, until all the solution is soaked; and having dried them, burn them to a powder, which preserve for use. When you gild any thing with this powder, let the metal you intend to gild be boiled and scraped, that it may be clean and fresh; wet a piece of cork with spittle, or water, and with it take up some of the powder, rubbing the places of the metal you are about to gild, until it is yellow; after which, brush and polish it. You may use, instead of cork, a soft leather, sewed or tied to the round end of a little stick. *Or*,

Take of the finest gold the quantity of two penny-weights, and dissolve it in *aqua regia*; add to this solution the weight of the gold of refined nitre, let that also dissolve; this done, dip a fine little linen rag until it has soaked up all; dry it gently, and burn it to powder. With this powder, and fresh water, gild your silver, by rubbing it with a cork, or a leather fastened to the nob end of a stick.

Another Powder to gild with.

Take refined gold; beat it very thin; make it into little rolls; fling it into *aqua regia*; put it in a matrass over a slow fire, until all the gold is dissolved, and the solution is turned of a yellow colour; then throw into it some pulverized nitre, by little and little, (as much as it will consume): now take some long narrow slips of old fine linen, draw them through the liquid, and when they are thoroughly wet, hang them in the air to dry, in a glass bowl, or a piece of a broken bottle, and, when dry, light them with a coal, and let them thus, without flaming, consume to ashes. With these ashes you may gild, rubbing it on the silver with a piece of cork. *Or,*

Take a penny-weight of gold, with an equal weight of nitre, and *sal-ammoniac*, all which put into a matrass, with three quarts of *aqua fortis*; then put the gold, nealing hot, into it, and as soon as the gold is dissolved, take some dry linen rags, dip them therein, dry and burn them, by a candle, to tinder, and preserve it for use, as has been said above.

A quickening Water.

TAKE one ounce of quicksilver, and as much *aqua fortis*; let them be put together into a glass, and after the quicksilver is dissolved, add to it five ounces of fresh water; warm it, and it will be fit for use. *Or,*

Take one ounce of *aqua fortis*; put it into a matrass; add to it a quarter of an ounce of mercury, and let it dissolve; then take fresh river water, and mix it with that in the glass, and make it lukewarm: let it stand close shut up, and you will have a good quickening water for gilding.

Another Water-gilding upon Silver.

TAKE copper-flakes, pour strong vinegar thereon, add to it alum and salt, equal quantities of both; set them on a fire, and when the vinegar is boiled to a fourth part, throw into it what metal you design to gild, and it will acquire a copper colour. If you continue boiling it, it will change into a fine gold colour. This is a fine secret for goldsmiths to gild silver, for the boiling it in that liquid gives the gilding a high and rich colour.

A Water which will give Silver a Gold Colour.

TAKE sulphur and nitre, of each an equal quantity, grind them together very fine, and put them into an unglazed vessel, cover and lute it well; then set it over a slow fire for twenty-four hours, and what you find remaining, put into a strong crucible, and let it dissolve; then put it into a phial, and whatever silver you anoint with it, will have a gold colour. *Or,*

Take sulphur half a pound, nitre three quarters of a pound, mix both together, and grind it fine, and proceed as above, or set it twenty-four hours on hot ashes, then take it out and grind it again. Of this powder, take one third; mix it up with three quarterns of running water: mix it well, and you will have a red water, like blood, which will tinge silver, copper, or brass of a fine gold colour, after it has lain therein ten days.

A Method to mould a Cup, one side Gold and the other Silver.

TAKE a plate of fine silver; flat it, and file it rough all over on one side, raise with a graver little points upon it. Then take a piece of gold in proportion to what thickness you would have it, form it exactly to the dimensions of the silver, in a flat square; neal both the gold and the silver red hot, then lay them quick on one another, and with a wooden hammer strike them gently together: when thus you have united these two metals, you may make thereof what you please, one side will be silver and the other gold.

To adorn Gold, Silver, or Brass, with Embellishments of Glass.

TAKE fine pulverized *Venice* glass, of what colour you please; grind it upon a stone; temper it with oil; and melt it over a clear charcoal fire; it will look fine and beautiful, especially if the ornaments are well designed on the metal, previously to covering it with glass.

OF HEIGHTENING THE COLOUR OF GOLD AND GILT WORKS.

UNWROUGHT gold and silver want considerably of that lustre and brightness they appear in at goldsmiths shops; for there they undergo several operations, and are heightened by gilding wax, colouring and helling; each of which shall be separately explained.

Gilding Wax, used for Gold, or gilded Work.

TAKE four ounces of clear wax, three quarters of an ounce of verditer, half an ounce of copper flakes, half an ounce of red chalk, quarter of an ounce of alum; melt the wax, and put the other things, finely powdered, into it, and stir it well together; let it cool; and form thereof round sticks like sealing-wax: when you have occasion to make use of it, first heat your gold, and then rub it over with this wax; then neal it, and draw it nimbly through boiling hot water and tartar, and it will give the gold a deep colour.

To give Gold a high Colour.

TAKE clear wax one pound; crocus of copper an ounce and a half; sal-ammoniac, fine terra-verte and alum, one ounce of each; red chalk, half an ounce and one drachm; crocus martis and tutty, of each half an ounce; nitre, two drachms; mix all these ingredients together, and after you have pulverized them, stir and mix it well with melted wax, which being spread over the gilded work, and then nealed, as has been observed before, it will give the gold a surprising beauty. *Or,*

Take two pounds of wax, one pound of red chalk, one pound of white vitriol, and four ounces of *æs ustum. Or,*

Take eight ounces of clear wax, one ounce and a half of *terra verte*, one ounce of *æs ustum*, one ounce of red chalk, and half an ounce of alum; dissolve the wax, and put these ingredients into it; let it cool; then form it into sticks like sealing-wax; with this, after you have heated your gilded metal, rub it over; then burn it off, and it will give the gold a deep colour.

Nuremberg Gilding-Wax.

TAKE two pound of wax, two pound and one ounce of red chalk, one ource of vitriol, half an ounce of *æs ustum,* three ounces of verdigrise, and half an ounce of borax. *Or,*

Take four pounds of clear wax, one pound eight ounces of red chalk, one pound eight ounces of white vitriol, fifteen ounces of verdigrise, three ounces of borax, and fifteen ounces of *æs ustum;* beat them fine, and mix them together: when the wax is melted, stir it until you perceive it to cool, and then put in the ingredients, and stir them well together: when cold, form them into sticks like sealing-wax.

To make all Metals malleable.

Take mastich, frankincense, myrrh, and borax, of each half an ounce, pulverize and mix them together, and when your metal is melted, fling in it some of the powder, and you will be surprised at the effect.

How to quicken Brass for gilding.

Dissolve sal-ammoniac in white-wine vinegar, and with it anoint your work; this will cause it to receive the mercury.

OF SEVERAL GOLD COLOURS, WHEREBY GOLD, OR GILT WORK, AFTER IT HAS BEEN HEIGHTENED WITH GILDING-WAX, RECEIVES ITS PROPER COLOUR.

A Silver Gold-Colour, or a Colour for Gilt Silver.

Take one ounce of verdigrise, one ounce of nitre, one ounce of vitriol, half an ounce of sal-ammoniac, half an ounce of borax; grind them fine; boil them in half a pint of urine, to half the quantity; then with a brush dipt in this liquid, brush over your gilt work; put it upon a clear charcoal fire, and when you see it turn black, take it off the fire and quench it in urine.

A Green Gold-Colour.

Take two ounces of nitre, two ounces of vitriol, two ounces of verdigrise, and one ounce of sal-ammoniac; mix and grind them with vinegar. *Or,* Take four ounces of verdigrise, four ounces of sal-ammoniac, two ounces of vitriol, two ounces of *æs ustum*, one ounce of nitre; grind them with vinegar, and colour your gold with it.

A French Gold-Colour.

Take four ounces of salt, two ounces of alum, two ounces of sal-ammoniac, two ounces of *æs ustum*, one ounce of nitre; grind them with vinegar. *Or*,

Take four ounces of sal-ammoniac, four ounces of verdigrise, two ounces of nitre, one ounce and a half of clean copper-flakes; grind them with vinegar.

A fine Gold-Colour.

Take melted nitre, and black vitriol, an equal quantity of each; let them boil half away in a clean pipkin.

Another Gold-Colour.

Take one ounce of verdigrise, one ounce of sal-ammoniac, one ounce of red chalk, one ounce of fine salt, grind all together, and boil them with vinegar. *Or*,

Take one ounce of nitre, one ounce of verdigrise, one ounce of vitriol, one ounce of sal-ammoniac; grind each ingredient, separately, in a clean mortar; then mix and put them in a clean pan, with water, and boil them nearly half an hour.

A Green Gold-Colour.

Take four ounces of sal-ammoniac, four ounces of verdigrise, two grains of nitre, and grind them in vinegar.

A White Colour for Gold.

TAKE two ounces of nitre, one ounce of alum, and one ounce of salt; pulverize and mix them well together; then take a piece of a broken crucible; put it in the fire, and let it be red-hot. Wet the work you design to colour, and roll it in the powder; then put it on the red-hot piece of crucible, and the colour will boil up; when it melts, turn the piece of work with your tongs, and when the colour is quite fluid, and is growing yellow, take it out, and lay it upon a clean brick, or anvil, until it is cold. Then take an unglazed pot, or a large crucible; fill it almost with clean water; put into it a handful of salt, and the quantity of a filbert of ground tartar, and six or eight drops of *aqua fortis*: let them boil; then put your work into it, and boil it until the dross of the white colour is taken off; then scratch-brush it.

To colour an old Gold Chain as if it were new.

TAKE urine, and dissolve therein sal-ammoniac; boil the gold chain in this, and it will have a fine colour.

A Green Colour for Gold Chains.

TAKE four ounces of sal-ammoniac, four ounces of verdigrise, one ounce and a half of nitre, half an ounce of white vitriol; make a powder thereof, mix it with vinegar, and boil your chain in it.

To give Gold a high and fine Colour.

TAKE red calcined vitriol, or colcothar of vitriol, three ounces, sal-ammoniac two ounces, and verdigrise one ounce; grind them together and keep them dry. When you would colour your gold, moisten it, and strew this powder over it; neal it often, and quench it in pump-water.

Another fine Colour for Gold.

TAKE verdigrise, sal-ammoniac, nitre and vitriol, an equal quantity of each; grind them well together; pour vinegar upon them; grind them again, as painters do their colours, and let them dry; then moisten, grind, and dry them again; repeat this for several times; then lay up your powder carefully. When you would colour gold, wet it with urine; rub it with a brush; fling the above powder upon it, and lay it on red hot coals, and it will turn black; then quench it in urine, and rub it with a wire brush: in this manner you may proceed with the other colours.

To bring pale Gold to an high Colour.

TAKE verdigrise; pour vinegar upon it; stir it well; anoint your gold therewith; heat it in the fire, and quench it in urine.

To make Silver yellow throughout, and to give it the Colour of Gold.

TAKE common *aqua fortis*; dissolve therein as much silver as you please; to eight ounces, take four ounces of *hepatic aloes*, six ounces of turmeric, and two ounces of prepared tutty that has been several times quenched in urine; put these to the solution of the silver; they will disssolve, but rise up in the glass like a spunge, so the glass must be large, to prevent the running over; then draw it off, and you will have ten ounces of silver, which is as yellow as gold.

N. B. The two ounces increase in the weight, by the tutty, will not stand the test, but be lost when melted down with lead, in cupellation.

A Water to give any Metal a Gold Colour.

TAKE fine sulphur, and pulverize it; then boil some stale spring, or rain, water; pour it hot upon the powder, and stir it well together; boil it, and put into it one ounce of dragon's blood; after it is well boiled, take it off and filter it through a fine cloth: put this water into a matrass, after you have put in what you design to colour; close it well, and boil it, and the metal will be of a fine gold colour.

Another Water wherewith one may tinge any Metal of a Gold Colour. A curious Secret.

TAKE *hepatic aloes*, nitre, and *Roman* vitriol, each equal quantities; distil them with water in an alembic, till all the spirits are extracted; it will at last yield a yellowish water, which will tinge any sort of metal of a gold colour.

To colour Gold.

TAKE a lock of human hair, of about a finger thick; lay it on live coals, and hold the gold with a pair of tongs over it, to receive the fumes thereof.

To give Gold a fine and high Colour.

TAKE one ounce of sal-ammoniac, two ounces of copper-flakes, one ounce of distilled verdigrise; grind all well together; put the mixture into a matrass; pour upon it one quart of good distilled white-wine vinegar: let it thus dry and boil away; then grind it fine, strew it on a glass plate, and set it in a cellar, where it will turn into an oil:

this is again to be gently coagulated, and then ground and mixed with sublimate mercury; put half an ounce of it, wrapt up in bees-wax, into the quantity of a pound of gold that is in fusion, and it will give it a high and fine colour.

To give gilded Work a fine Colour.

TAKE clean salt and sulphur; boil them together, with water, in an egg-shell, after taking away the inside film; take care you do not give too much fire to burn the egg-shell; with this liquid wipe over your gilding, and it will make it of a much brighter colour than it was before. *Or*,

Take powder of sulphur, and bruised garlic; boil these in urine; neal your gold; quench it therein, and it will give it a fine colour.

To brighten Spots in gilding.

TAKE alum; boil it in clear water; put your work into it: this will restore the colour again, and remove the spots.

To give old Silver-Lace, or Trimmings, the Beauty and Colour of new.

TAKE powder of alabaster, or fresh plaster of Paris in powder; put it dry into a pipkin, and let it boil as long as it can; then take it off the fire; when cold, lay your lace upon a cloth, and, with a comb-brush, take up some of that powder, and rub therewith both sides, till it is as bright as you would have it; afterwards polish it with a smooth stone. *Or*,

Take ox-gall, or the gall of a large jack, and some water; mix together, and with it rub your gold or silver, and you will see the colour change to your liking.

OF THE HELL, OR HELLING OF GOLD.

This is the finishing stroke of either gold or gilt work; and is performed, after it has undergone the operations with the gilding wax and gold colours, as has been shewn in the foregoing articles. The following are the different receipts of different masters. The ingenious and judicious will, by experiments, soon discover which of them is best, and make his choice of such as he approves.

To Hell Gold, or Gilt-Work.

TAKE two ounces of tartar, two ounces of sulphur, and four ounces of salt; boil this in half water and half urine; dip your gold, or gilt work, into it, and it will give it a fine lustre. *Or,*

Take eight ounces of salt, two ounces of tartar, two ounces of sulphur, half an ounce of alum; boil these in water and urine, and draw your work through, and it will answer your expectation. *Or,*

Take eight ounces of sulphur, eight ounces of alum, eight ounces of yellow arsenic, sixteen ounces of tartar, sixteen ounces of salt; boil them in water and urine. *Or,*

Take three ounces of sulphur, one ounce of alum, one ounce of arsenic, half an ounce of turmeric, and half a grain of antimony; grind them very finely together; then boil them in urine and water, and stir the ingredients gently together; boil the mixture a little, put the gilded plate into it, and boil it till the colour is bright. *Or,*

Take eight ounces of yellow arsenic, sixteen ounces of sulphur, sixteen ounces of tartar, sixteen ounces of burnt alum, three ounces and a half of salt; boil the mixture in urine and water. *Or,*

Take sifted ashes and antimony finely pulverized; with these make a lye, and with a brush rub over the gilt silver. *Or,* Take one ounce of white tartar, one ounce of grain sulphur, and nine ounces of salt: grind them together like flour; then take a copper sauce-pan with fresh water, and let the water boil: put into it one grain of crude yellow arsenic; take of the ground ingredients three spoonfuls, and let it boil; after that, you may draw your work through it, and make it as high as you will; and it will come out clear and with a fine lustre.

How to take off the Gold from Gilt Silver Tankards or Cups.

To take off the gold from such plate, take sal-ammoniac one part, nitre half a part; grind them both to a powder; wipe over the gilded part with oil; strew the powder upon it, and lay your plate into the fire to heat it well; then take it out; hold your plate over an earthen dish, in one hand, and, with the other, beat it with an iron; the powder will fall into the dish, together with the gold; which you may separate in the manner as has been directed.

Another Method.

Put quicksilver in an earthen dish; heat it lukewarm; in this turn your silver cup, or other utensil, and the gold will separate from the silver, and join the quicksilver; when you see the gold is all come off the plate, take it out and pour the quicksilver with the gold, after it is cold, into another dish; if any place still retains some gold, repeat it, till you perceive no more upon it; then strain the quicksilver through a leather; what remains put into a retort, on hot sand, or ashes, and force the rest of the mercury from it into a receiver with water; what is left, melt together, and refine the gold as has been shewn before.

An approved Method to take off the Gilding from Silver.

TAKE a glass utensil, put aqua-fortis in it, the quantity whereof must be according to the bigness of your work; take no more than one-eighth of an ounce of sal-ammoniac to one ounce of aqua-fortis; beat your sal-ammoniac fine; put it into the aqua-fortis, and set it over the fire till it grows warm; and when you perceive the sal-ammoniac to work, then put in the gilded silver, and when you observe your work to become of a black colour, then the gold is taken off of it; if there is a pretty large quantity of work, let it lie for half an hour, or an hour, before you take it out, which you must do with a pair of wooden pliers; when it is taken out, put it into clean water; then neal it, and afterwards boil it with tartar; repeat this three times successively, and your silver will look fresh and new.

How to get the Gold out of Aqua Fortis.

TAKE a copper bowl, or cup; put into it a glass full of water, and pour in the aqua-fortis which contains gold; then add to it a quarter of an ounce of borax, and boil it up: let it stand all night; in the morning pour it off gently, and the gold will be settled at the bottom: dry it by degrees; and, when dry, put a little borax to it, and melt it.

To give Silver Utensils a Lustre.

DISSOLVE alum in a strong lye; scum it carefully; then mix it up with soap, and wash your silver utensils therewith, with a linen rag.

To separate Gold from gilded Silver, by Cementation.

TAKE red calcined * vitriol, or *colcothar*, one part, salt, one part, red lead, half a part; pulverize and mix them all well together; with this mixed powder cover your gilded silver all over in an earthen pan; put it into a furnace, and give it a slow fire, to prevent the melting of the silver: the powder will attract the gold, which you may reduce by melting it with lead, and by separating it by cupellation.

OF SEVERAL
SORTS OF SOLDER FOR GOLD AND SILVER.

Filings-solder for Silver Chain-work.

MELT three parts of fine silver, and one part of brass; when in fusion, fling into it a little quantity of yellow arsenic. *Or,*

Take one part of yellow arsenic, and one part of copper, and melt and granulate: of this take one part, and of fine silver four parts; melt them together; cast them into an ingot, and, when cold, file to a fine dust.

A Solder for Silver.

MELT two parts of silver; then put to it one part of thin beaten brass, or tinsel; but do not keep it too long in fusion, lest the brass should fly away in fumes.

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* The calcination of vitriol is performed thus: put what quantity you please of green vitriol into an earthen pot, unglazed; set the pot over the fire, and boil it till the moisture is consumed, and the matter turns into a greyish mass, drawing towards white; this is called white calcined vitriol. If you calcine this white vitriol a good while over a strong fire, it will turn as red as blood: this is called *colcothar*. Colcothar of vitriol may be had at the shops.

Another for Coarse Silver.

Four ounces of silver, three ounces of brass, a quarter of an ounce of arsenic; melt them together, and pour them out quick.

Another Silver-Solder.

Melt two ounces of silver; one ounce of tinsel; add to them half an ounce of white arsenic; pour it out quick, and it is a very good solder. *Or,*

Melt one ounce of fine silver, and one ounce of thin brass: when both are well melted together, fling one ounce of white arsenic upon it; let it melt, stir it well together, and pour it out quickly.

Of good Solder for Gold.

Melt copper and fine silver together, of each one part; of fine gold, two parts. *Or,*

Take one penny-weight of the same gold your work is of, and allay it with three grains of copper, and three grains of silver.

The Manner and Way of Soldering Gold or Silver.

Beat the solder thin, and cut it into little bits, or pallions; then take the work which is to be soldered, join it together with fine wire twisted over it; wet the joinings with a pencil with water, mixed up with borax; then lay the bits, or pallions, of solder upon it, and strew some powdered borax over; lay the work, if it be a button or some other small thing, upon a large coal, and blow with your blow-pipe through a large lamp-flame upon it, to melt it.

After this, boil the work either in alum-water, or else in *aqua-fortis*, to clear it from the borax; dry it on a charcoal fire; then file or turn it; if it be silver, boil it white in the following manner:

Take the work; lay it on a clear fire, and, when red hot, take it out, and put it by to cool; in the mean while, set a copper-pan, not tinned, with water upon the fire, into which put one part of fine salt, and one part of tartar; boil these together, yet not too fiercely, to prevent its boiling over; after it is well boiled, lay the work, when it is a little cold, into it, and let it boil about six minutes; then take it off the fire, take out the work, and put it immediately into clean water; take it out, and scratch it well with a wire brush, to clear it of the coat; then repeat this work over again; neal it once more, boil it in tartar and salt, and proceed as before; then take black burnt tartar, and mix it with a little water into a paste, with which rub over the work; then neal it on a clear coal fire; take it out, and brush the work well of the burnt tartar in clean water; put it once more in the tartar-water in which it was boiled, and let it boil four minutes; then wash it in cold water, and dry it with a clean rag, and it will be of a white and beautiful pearl colour.

To Solder a Ring set with Stones.

TAKE a large charcoal; put two or three penny-weights of silver upon it; melt it with your blow-pipe and the lamp; then, after you have clapped a thin pallion of silver solder betwixt the opening of the ring, dip it into it; but as soon as you see the pallion run, take off your ring instantly.

A Powder for soldering, equal to Borax.

TAKE the best hard *Venice* soap; scrape it as thin as possible; let it dry, between two papers, in the air; then rub it to a powder; put it into an unglazed pipkin; set it on a gentle coal fire, and let it, by degrees, fumigate until it has no moisture at all; then it is right. This you may use for all manner of work, and it will do, equal to *Venice* borax.

To melt in a Moment several sorts of Metals, over a Table.

TAKE two ounces of nitre, tartar one ounce, sulphur half an ounce; beat in a mortar to a powder; then take one ounce of filed metal, (of any sort) mix it well together; put it into a small crucible, or a hollow charcoal; light it with a little splinter, and it will melt immediately.

Another Manner of doing it.

TAKE one ounce of nitre, half an ounce of sulphur, and a quarter of an ounce of gunpowder; grind them well together, and put half of this powder into a small crucible, or, if you will, into an egg-shell; then put a farthing, or six-pence, or any other metal, upon it, and, upon that, put the other half of the powder; press it down with your finger; then set it on a stone; light it, and it will melt immediately.

N. B. A gilt cup, or other plate, if anointed with salad oil, and this powder flung upon it and lighted, takes off the gold, and melts it to a mass.

To make Aurum Sophisticum, or Mimick Gold.

TAKE fine distilled verdigrise eight ounces, tutty four ounces, borax twelve ounces, nitre one ounce and a half; pulverize, and mix them all together; temper them with oil, with a wooden spatula, to the consistence of a paste; then put a crucible into a wind-furnace, heat it red hot, and convey your mass into it with a wooden spatula, by little and little; when all is in, cover it; fill your furnace with coals all over the crucible; let it stand in a fierce fire, to melt; let it cool of itself; then break the crucible, and you will find, at the bottom, a fine metal like gold, weighing about four ounces, out of which you may form and make what you please: it will be as malleable as real gold.

Another.

TAKE fine and clear wire-copper four ounces; melt it; then fling into it one ounce of *spelter*, i. e. *zinc*; stir it well together with an iron spatula; blow the fire brisk, to bring it into fusion, but, before you pour it out, put in some borax, and it will give it a peculiar beauty; then cast it into an ingot; out of this ingot you may draw wire for chains, and work it in what form or shape you please; after you have filed it, and rubbed your work well with tripoli, then give it the finishing, with a mixture of one grain of tripoli, and six grains of flower of sulphur, put upon a piece of leather; rub your work as usual, and it will have a fine gold colour.

Another.

TAKE *spelter* one ounce; of the finest and softest copper two ounces; melt the copper in a crucible; when melted, fling into it borax two grains, and sal-ammoniac two grains; and, lastly, fling in the *spelter*: pour it into an ingot, and you will have a fine gold-coloured metal.

To make a curious Yellow-mixed Metal, resembling Gold, and which may be drawn into fine Wire.

TAKE eight ounces of tartar; put it into a crucible, and neal it by degrees; then take pulverized dry nitre, and fling it on the red hot tartar, and it will melt into a yellow mass; take it from the fire, and let it cool; then take clean copper; keep it in fusion until it is like water, and fling in (to eight ounces of copper) the first mass; give the crucible a strong reverberatory heat, until in fusion; then take the best *spelter*, or *zinc*, half an ounce, *tutty* and *Venice salacani** half an ounce; put it to the melted copper, and presently you will hear a crackling noise, and see a yellow fume and flame ascend; stir this copper, and the other ingredients together, with an iron wire, until it is burnt away; let it stand a little in the flux, and then, after you have rubbed your ingot with wax, pour it in, and it will be so pliable as to be drawn into wire, and of a high gold colour; you may work, form, finish, and colour it as you do other gold.

Another Method to make a Metal resembling Gold.

TAKE fine copper filings one pound, fine nitre eight ounces, prepared tutty six ounces, borax six ounces, *hepatic aloes* four ounces; mix all well together, and incorporate the mixture with linseed oil into a mass; put it into a clean crucible, and cover it at top, a finger's height, with subtilly pulverised *Venice* glass; lute it well; put it into a wind-furnace; fill the same with dead coals, and then put live coals upon them, *i. e.* light the fire from the top, to go downwards; blow it for an hour, and give it a fierce fire; then let it cool of itself, take out the crucible, and break it, and you will find at the bottom a very fine metal, like gold, this melt again, and add to it one pound two ounces of *mercury sublimate*, and two ounces of prepared tutty, both clapped up in red sealing-wax; stir it well with a dry stick; then cast it into a mould, and make of it what you please. *Or*,

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* An article unknown; and it is, probably, of little use in the receipt. *Ed.*

Take six ounces of distilled verdigrise; grind it fine in a marble mortar; beat eight ounces of prepared tutty, four ounces of nitre, and four ounces of borax, into a coarse powder: moisten them with oil of turnips,* and stir them in an earthen dish, together, until all is well mixed: then put a crucible into a wind-furnace, and, when red hot, convey the said mixture into it with a wooden spatula; cover it; add more coals, and give a brisk and strong fire all over the crucible. In about half an hour, put a little stick into it, and try whether the matter be dissolved, and in fusion like water; if so, then it is time to pour it out; but if you find still some matter remain, stir it about with your stick; cover it, and give it a brisk fire, until you find it is all dissolved: then pour it out into a mortar, or brass cone, and you will have a fine gold-coloured metal.

To make Brass.

Take of copper what quantity you please; add to it a third part of powdered *lapis calaminaris*; put them together into a melting pot, and be in fusion for about an hour; then pour out the brass.

To Silver Copper, or Brass.

Take of fine silver one ounce; sal-gemmæ, *i. e.* rock-salt, and sal-ammoniac of each six ounces; glass-gall six ounces; beat the silver thin, and then put it into one ounce of aqua-fortis; let it dissolve; when dissolved, fling a little salt into it, and the silver will settle like a white powder at the bottom; then pour off that water, and put on fresh; repeat it, until the silver calx has lost all the flavour of the *aqua-fortis*; dry this, then take the above ingredients, and grind them well on a clean stone; when you have well ground them, mix and grind them and the silver calx together, with a little water, until the mixture is like a thick paste; put this up in a clean glass, and when you would silver, take care that your metal be filed and brushed clean; rub it over with the above matter, and lay it on live coals; when it has done smoking, scratch it well, and rub it over again with the silver matter; do this three times successively, and you will have a fine silvering.

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* Common oil will probably do. *Ed.*

Another way.

TAKE fine silver; dissolve it in *aqua-fortis*; then add to it the same quantity of water as you had done of *aqua-fortis*; take common salt, and fling it into the mixed waters, and the silver will precipitate to the bottom, like a powder; when settled, pour off the mixed water, and sweeten this silver calx by pouring fresh water to it, shifting it until all the sharpness is removed. Then drain off the water, and let the silver dry; of which take a quarter of an ounce, white calcined tartar one ounce, common salt half an ounce; then beat and mix them well together, and with *aqua-fortis* grind them upon a stone; then let them dry, and you have a powder ready to silver with. If you would silver either poor silver, copper, or brass, then rub the powder well in, after you have moistened it with water, with a piece of cork, to your mind; then lay it on a coal fire until it is red hot; let it cool; then boil it in water with tartar and salt, and after it is boiled, wash it in clean water.

What Metals are most proper to incorporate with Silver.

SILVER will easily mix and incorporate with fine clean copper, of each an equal quantity: if you add more copper than silver to your composition, it loses the whiteness, and is not fit to make any utensils with. All other metals are of a contrary nature to silver, as lead, tin, iron, brass, &c. therefore they are to be avoided.

To silver Brass, in Fire.

TAKE calx of fine silver half an ounce, one ounce of sal-ammoniac, three ounces of salt; mix and grind these well together. When you use it, grind and temper it together with water, and rub your brass therewith; neal it brown; then quench it in water wherein tartar has been dissolved; scratch it, and finish your work by polishing it as you see requisite.

A Powder to silver Copper or Brass with, by rubbing it with the Finger or Thumb.

DISSOLVE a little silver in *aqua-fortis*; add to it as much tartar and sal-ammoniac as to make it like a paste, whereof make little balls; dry and pulverize them: if you take some of this powder on your wetted thumb, and rub it upon the copper or brass, it will give it the colour of silver.

A silvering on Copper.

DISSOLVE fine silver in *aqua-fortis*; pour it upon pulverized tartar; and then draw your *aqua-fortis* clear off, and there remains a black matter; with this rub your copper; then neal it well, and boil it in tartar and salt.

To

To silver Copper, or Brass, by boiling it.

Take three ounces of salt, twenty-six leaves of silver, a quarter of an ounce of tartar, and half an ounce of alum; boil these in an earthen pipkin, and stir well together; put what you design to silver into it; pour water upon it, and let it boil; after it is well boiled, scratch-brush it; put it in again, and boil it; then scratch it again, and repeat this until it is to your mind.

To boil Brass, like Silver.

Take one part of the filings of good pewter; add to it one part of white tartar, and mix together; then take an unglazed pipkin; put these two ingredients, and the Brass (which before must be well scratched and cleaned) into it, and let it boil.

To silver Copper, Brass, Steel, or Iron, so as not to come off, except it be made red hot.

Take urine which is made in the morning; cover it, and let it stand a whole month; put it into an earthen pot and let it boil; skim it, and when the third part is evaporated, take two pints of urine, one ounce of tartar, and an ounce of gall-stone; put it in, and let it boil once up. This liquid keep clean; and if you would silver any metal, take brick-dust on a wet woollen rag, and rub therewith your iron, or other metal, until it is clear and fine, and put it 24 hours in the prepared urine; afterwards dry it, and where you design to silver, rub it over with quicksilver; you must lay it on thin, with an iron spatula which has lain two hours in the urine; then rub it on with a soft woollen rag, and it is a fine bright silvering.

To silver all Sorts of Metals.

TAKE as much *aqua-fortis* as you think there is occasion for; put it in a glass, and set it on hot ashes; then put in your quantity of silver, which first has been beaten very thin, and cut into little shreds. When your silver is dissolved, take it off the ashes, and mix that liquid with as much white tartar as will make it like a paste: if you rub brass, copper, or any other metal, with this, it will be like silver.

PART III.

THE ART OF

ENAMELLING IN ORDINARY,

AND THE METHOD OF

PREPARING THE COLOURS.

THE ART OF PAINTING IN ENAMEL.—CURIOUS INSTRUCTIONS HOW TO MAKE ARTIFICIAL PEARLS.—OF DOUBLETS AND FOILS, AND THE MANNER OF COLOURING THEM.—THE ART OF COUNTERFEITING PRECIOUS STONES, WITH OTHER RARE SECRETS.

Of Enamelling in Ordinary; and of preparing the Enamel-Colours.

ENAMELLING is the art of laying a coat of enamel upon metals, as gold, silver, copper, &c. and of burning-in various colours by the fire, so as to preserve indissoluble the figures and letters which are formed of them. Several receipts are in the possession of curious artists, many of whom excel in this useful art; of these we shall now proceed to give the detail.

To

To prepare the Flux for Enamel-colours.

TAKE four ounces of red lead, and one ounce of well washed and clean sea sand; melt them together, and put them in a cold ingot.

Another Sort of Flux, which is very soft.

TAKE one ounce of white lead, a quarter of an ounce of red lead, twelve grains of pebble; heat the pebbles red hot, and quench them in urine; repeat this until you can crumble them to an impalpable powder between your fingers; then beat them fine; put them with the ingredients into a clean crucible; lute it well, and when dry, give it a fierce fire for half an hour, or longer, then take it off the fire, and let it cool of itself; break the crucible, and melt the contents again in another clean crucible, and pour it into a clean ingot, or a bright brass weight-scale, and then it will be fit for use; beat and grind it in an agat mortar*, to an impalpable powder. When you mix your colours therewith, temper as much as you have occasion for with oil of spike, *i. e.* spike-lavender.

A Green Colour.

A *green colour* is best made by *mixing blue and yellow* together, and by adding a little brown, if it be required to be dark. The reason is, that greens are otherwise made from copper, which must retain some portion of the acid in which it was dissolved if it remain green; and if you dissipate all the acid it becomes dusky, which will happen on exposing the enamel to fire.

Take copper, and dissolve it in *aqua-fortis*; then evaporate. Take of this one part, and three parts of flux. *Or,*

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* A mortar of Wedgwood's ware is as good, and much easier obtained. *Ed.*

Take a copper plate, and with a piece of pumice-stone with water, rub it over; receive the water into a bason or dish, and let it settle; pour off the water, and neal the settling; then take thereof one part and three parts of flux; and this makes a good and fine green.

Dark Green.

TAKE green enamel two parts, yellow smalt one-eighth part, and six parts of verditer.

Yellow Colour.

TAKE fine King's yellow, and neal it in a crucible; one part yellow, and three parts flux.

A high Yellow.

TAKE gold-yellow enamel, vitriol and flux; grind and temper them to your mind with oil of spike.

Brimstone Colour.

TAKE calcined *Naples*-yellow one part, three parts of burned lead-yellow, and three parts of flux.

A Black Colour.

TAKE three-fourths of black enamel, and one-eighth of scales of iron; grind these with water, in an agate mortar, very fine; draw the water from it, and dry it upon hot plates; then grind it with oil of spike. *Or,*

Take manganese; neal it upon a tile; the blacker it comes off the fire the better; take one part thereof with three parts of flux, ground with oil of spike.

A good Red.

TAKE green vitriol; grind it fine, and dry it in the sun; then neal it between two crucibles, well luted, so as to prevent the air's coming to it. Take thereof one part, and two parts and a half of flux; melt them together, and when you use them, grind them with oil of spike.

Another.

TAKE *Roman*, or blue, vitriol, about the quantity of a walnut; grind it in a stone mortar, very fine; dry it, and then neal it to a brown colour; take the lumps, and put them into a new glazed pipkin, and pour *aqua-fortis* upon them; then wash the *aqua-fortis* from them again, and let it evaporate; take afterwards one part thereof, and three parts of flux; grind it with oil of spike.

Another good Red.

TAKE brown red, colcothar of vitriol, or *Paris* red, and a little flux; grind them fine with oil of spike. *Or,*

Take vitriol, calcine it in a clean crucible, and when dry, pour a little *aqua-fortis* and vinegar on it; neal it well; after that wash it with clean water, till it has no taste; dry it over a fire; and when dry, neal it again; then take of this one part, and three parts of flux.

Blue Colours.

TAKE fine smalt; wash it well with clean water, as fine as possible; put a little flux to it, and grind it with oil of spike. *Or,*

Smalt may be used alone without the flux-powder, ground with oil of spike. *Or,* Take ultramarine one part, flux four parts; grind them with oil of spike.

Green.

TAKE verditer, and a little ground flux; grind them with oil of spike.

Grass Green.

TAKE verditer, and neal it in a crucible; take one part of it, and three parts and a half of flux.

Brown Colours.

TAKE crocus martis one part, flux two parts, grind them with oil of spike.

Purple Colour.

TAKE one part crocus martis, one part smalt, and three parts flux. *Or,*

Take blood-stone, and grind it with vinegar, when it is fine, wash it clean, and burn it over a candle on a thin plate.

Hair Colour.

TAKE umber, and neal it in a crucible; then take one part thereof, and three parts of flux; grind them with oil of spike.

Fawn Colour.

TAKE vitriol, glow it as hot as possibly you can, *i. e.* give it a red heat; then take of it one part, and three parts flux.

Carnation Colour.

TAKE yellow ochre, and glow it in a crucible very hot; after that let it cool, and beat it in an iron mortar, and, if it is not of a fine colour, neal it again; take of this one part, and three parts and a half of flux.

A steel Red for Enamel.

TAKE fine thin beaten plates of steel, and cut them into small shreds; put them into a vial with *aqua-fortis*, and when reduced over a slow fire, neal it; of this take one part, and three parts of flux.

OF THE ART OF PAINTING ON ENAMEL.

THE ancients that laboured in this noble art, were unacquainted with the beauties the moderns have discovered, particularly in the art of compounding colours for representing portraitures and history: the fine performances in those particulars are the admiration of every curious beholder. Besides their peculiar beauty and lustre, they have this advantage over all other paintings, that they are not subject to the injury of the air or weather, as paintings in oil or water colours; and unless they are rubbed or scratched with any thing harder than themselves, the colours will retain their beauty for ever, and be as fine and bright as when first done.

This art cannot be effected without fire, which always must be reverberatory, in a furnace so contrived that the fire may play all over the *muffle* that covers your work. To explain this more fully, see plate 4. When your reverberatory is building, let the mouth part of the muffle be placed fronting the mouth of the furnace, and be fixed in such a manner that the furnace fire may not play into it, nor the ashes drop upon your work.

Your furnace may be either round or square; it may be of iron or earth, no matter which; only let there be so much room in the inside as will contain the muffle, with a good charcoal fire round about to cover it: you must have a slice, or iron plate, to put your work upon, which, with a pair of tongs, convey into the furnace, and bring out again.

The metals fittest to enamel upon, as has been said, are gold, silver, and copper; but the best work is performed on gold, for silver makes the white enamel appear of a yellowish hue; and copper is apt to scale, whereby the enamel is subject to break in pieces; besides, the colours lose a a great deal of their charms and lustre to what they do upon gold. The gold used for this purpose should be the finest, else the impurities of a bad allay will have the same effect in the enamel colours as the silver or copper.

Your plate, of whatever metal it be, must be very thin, raised convex; both that and the concave side are laid over with white enamel; the convex side, whereon you paint, must be laid a small matter thicker than the other. You must observe, that the white enamel which you lay on the convex be ground with fair water in an agate mortar, and with an agate pestle, until it be fit for use: the enamel for the other side must be tempered with water wherein you have before steeped some quince kernels.

As to the enamel colours which you paint with, you must take great care that they be equally tempered, or your work will be spoiled; if one be softer than the other, when your work comes into the furnace and grows hot, the soft colour will intermix with the hard, so as to deface your work intirely: this may serve to caution you to make trial upon a white enamelled plate for that purpose, of all your enamels, before you begin your work: experience will direct you further.

Take particular care that not the least dirt imaginable come to your colours, while you are either painting or grinding them; for the least speck, when it is worked up with it, and when the work comes to be put into the reverberatory to be red hot, will leave a hole, and deface your work.

After you have prepared your plate with a white enamel, and it is ready to paint upon, apply your colours on an ivory palette, or a piece of glass, in just order, and first delineate your design with a dark red, made of crocus martis ground with oil of spike; put the piece in the muffle, and with a reverberatory fire, as before directed, fix that colour; and then proceed, remembering to dilute the thick and opaque enamel colours with oil of spike; and the transparent ones with fair water: by mixing blue and yellow enamel colour you have a fair green; blue and red a violet; red and white a rose colour; and so of other colours.

We shall here set down several other receipts for preparing enamel colours, which will not only serve for ordinary work, but for enamel-painting in miniature,

To prepare the principal Matter *for Enamel Colours.*

TAKE lead fifteen pounds, plate-tin ashes sixteen pounds; mix and calcine these, as directed in the first part; after you have calcined your lead and tin, search out the calx, and put it into an earthen pot filled with water; set it over a fire, and let it boil a little; after which, take it off, and pour the water into another vessel, which will carry the more subtil calx along with it; repeat this till you can subtilize no more of the calx, and the water comes off clean without any mixture. What gross part remains in the pot, calcine as before, and this repeat till you can draw off no more of the subtil matter. Then pour the water from all your receivers into one that is larger,. and evaporate it on a *slow* fire.

Of this calx take 12 pounds, frit of white sand, beaten and sifted, 12 pounds, nitre purified 12 pounds, salt of tartar purified * two ounces. Put these powders all together into a pot, place it in a glass-house furnace for ten or twelve hours to digest and purify. Then take and reduce it to an impalpable powder, and keep it in a close, dry place for use. Thus is your first or *principal matter* for enamel colours prepared.

To make Enamel of a Milk-white Colour.

TAKE three pounds of the fore-mentioned *principal matter*, twenty-four grains of prepared magnesia, and arsenic two pounds; put these together into a melting-pot, to melt and purify over a fierce fire; when the matter is melted, throw it out of the pot into fair water; and having afterwards dried it, melt it again as before; do this for the third time, changing the water; when you have thus purified it, and found the white colour answer your intent, it is done; but in case it has still a greenish hue, add a little more magnesia, and, by melting it over again, it will become as white as milk, and be fit to enamel with on gold or other metals: take it off the fire; make it into cakes, and preserve it for use.

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* You may buy salt of tartar purified, or you may purify it yourself. Calcine tartar of red wine in an earthen crucible, till it comes black; continue the fire till it changes to a white. Then put it into an earthen pan, glazed; fill the pan with clear water, and boil it over a gentle fire, so that in four hours the water may evaporate the fourth part; then take it off the fire, and after the water is settled and cold, pour it off by inclination into a clean glazed pan, and you will have a strong lye. Then pour clean water on, and let them boil as before: this repeat, till the water becomes insipid; then filter the lye; put it in glass veſſels upon a sand-bath, in a gentle heat, to evaporate, and at the bottom there will remain a very white salt. Dissolve this salt again in fair water, and let it stand two days to settle; filter it, and evaporate at a gentle fire, as before, and you will have a salt whiter than the former; repeat this three or four times, and your salt will be whiter than snow itself.

The same process may be employed on pot-ash, without calcining it as the tartar is; the same may be done also on pearl-ash.

A Turcoise Blue Enamel.

TAKE of the principal matter three pounds; melt and purify it in a proper melting-pot, then cast it into water; when dry, put it again into a pot, and being melted over again, add to it at four times this composition: scales, thrice calcined*, two ounces and a half; prepared zaffre forty-three grains; prepared magnesia twenty-four grains; stone-blue two ounces; mix and reduce these to a very fine powder; stir the matter very well with an iron rod, for the powders to incorporate. When your matter is thus tinged, observe well whether your colour answer your intention, before you empty the pot: if you perceive the tinging powders are too predominant, add more of the principal powder; and if too faint, add more of the tinging powders. Your own judgment must direct you in the management of this preparation.

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* To calcine copper scales, such as come from the hammer of braziers or copper-smiths: wash them from their foulness, put them into a crucible; place it in the mouth of a reverberatory furnace, for four days; after which, let them cool; then pound, grind, and sift them. Put this powder a second time into the furnace, to reverberate four days longer; proceed as before; and after it has stood again the third time for four days, reduce it into powder, and it will be fit for the use intended.

A fine Blue Enamel.

TAKE two pounds of the principal matter; one ounce of prepared zaffre, or of indigo blue; twenty-two grains of copper, thrice calcined; mix and reduce these to a fine powder, and put them into a melting-pot: when the metal is melted, cast it into water; then dry it and put it into the pot again; let it stand upon the fire until it is well incorporated; take it off; make it into cakes, and keep it for use.

A Green Enamel.

TAKE two pounds of the principal matter, one ounce of copper scales, thrice calcined, twenty-four grains of scales of iron, blue vitriol two ounces, yellow arsenic one ounce; mix and reduce these to an impalpable powder, and, at three several times, or in three several portions, fling it into the principal matter, stirring the metal so as to tinge it equally. When the colour is to your liking, let it stand for a while in the fire, to incorporate thoroughly; then take it off, and you will have a delicate green. *Or,*

Take * Feretto of *Spain* two ounces, forty-eight grains of crocus martis, yellow arsenic two ounces; pulverize and mix these well, and put them into a white glazed pot †;

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[*] Feretto of *Spain*, is thus prepared: stratify thin plates of copper with vitriol, in a crucible; put it in the mouth of a glass furnace for three days; then take it out, and add to the copper fresh layers of vitriol, stratifying them as before: now put the crucible in the same place of the furnace; repeat it six times successively, and you will have an excellent feretto. Beat this to powder, and it will tinge glass of an extraordinary beautiful colour.

[†] The best melting pots for glasses and fluxes are made of tobacco-pipe clay. They may be had of Meſſrs. Pugh and Speck, melting-pot manufactory, bottom of Booth-Street, Spital-Fields. *Ed.*

set it in the furnace to melt, and refine the matter; after which cast it into water; and when dried, throw it again into the pot: when melted, observe whether the colour is to your liking; if so, let it stand for some time longer to refine. If you find the colour too faint, add more of the tinging powder.

A Black Enamel.

TAKE of the principal matter two pounds, prepared zaffre one ounce, and prepared manganese one ounce; pulverize and mix these, and proceed as directed in the preceding colours. *Or*,

Take of the principal matter three pounds, zaffre one ounce, crocus martis, one ounce, feretto of *Spain* one ounce; pound and mix them, and proceed as directed before.

A Velvet-black Enamel.

OF the principal matter two pounds, red tartar two ounces, prepared manganese one ounce; pulverize these, and put them into a glazed pot, bigger than ordinary, because the matter will rise; for the rest, proceed as directed before.

A Purple-colour Enamel.

OF the principal matter two pounds, prepared manganese one ounce, indigo blue half an ounce; proceed as above. *Or*,

Principal matter three pounds, prepared manganese one ounce and an half, of twice calcined scales of copper three ounces, stone blue one ounce; pulverize and proceed as directed.

A Violet Enamel.

Of the principal matter three pounds, prepared manganese one ounce, thrice calcined copper scales twenty-four grains, terra verte one ounce; pulverize and mix these all together, and proceed as before directed.

A Yellow Enamel.

Of the principal matter three pounds, tartar one ounce and a half, prepared manganese six grains, yellow orpiment two ounces, arsenic one ounce; pulverize them, and proceed as before directed.

An excellent Red Enamel, of a very splendid ruby Colour.

This enamel is of a surprising beauty, and its lustre equals that of a red ruby. To prepare this, take equal quantities of manganese and nitre; let them reverberate and calcine in a crucible in a furnace for twenty-four hours; take it then off, and wash it well in warm water, to separate the nitre; dry it well, and the mass will be of a red colour: to this add an equal quantity of sal-ammoniac; grind this on a marble with distilled vinegar, as painters do their colours; dry it, and pulverize it; then put it into a strong matrass, and let it sublimate for twelve hours; break off the neck of your matrass, and mix all the volatile and fixed parts together, adding the same quantity of sal-ammoniac as there are flowers, and take care to weigh them before the composition; grind, pulverize and sublimate as before, repeating this until your manganese remains fuzible at the bottom of the matrass: this preserve to tinge your crystal with; and according to your liking, add either a greater or less quantity of the manganese, or of the crystal, until you have brought it to its degree of perfection.

A Rose Colour Enamel.

Take five pounds of ground crystal[*]; melt it in a crucible; add, at four different times, two ounces and a half of thrice calcined copper; stir the metal every time; then pour into it crocus martis and manganese prepared as directed; let it stand for six hours to cleanse, and if the colour is too light, add a little more crocus martis, until it be of a fine rose colour.

Observe that all the colours, (which are not pure enamel,) must be incorporated with the crystal, that they may vitrify the better, which else they would not easily do. Some workmen make use of rocaille; but that does not answer the purpose so well as ground crystal.

A fine Purple.

Take half an ounce of fine gold; neal it, and beat it into very thin plates; dissolve this in four ounces of aqua regia; put it into a glass cucurbit, and set it on warm ashes, or sand, to dissolve; put in it a small matter of nitre; when all is dissolved, drop two or three drops of oil of tartar into it, and stop the cucurbit close, to prevent its boiling over: then put in some more drops of oil, and repeat this until it hisses no more. After this put some lukewarm rain-water to it, and let it stand for some time, and a powder will settle at the bottom of the cucurbit; then pour off the water leisurely into an earthen, or glazed receiver; put more fresh water to the sediment, and repeat this until the water comes off clear, and free from the sharpness of the aqua regia. When the powder is settled, and all the water poured from it, then put it upon a piece of whited-brown paper, to separate it from the rest of the water; and dry it on a warm tile, or in the sun. To one part of this powder, add six parts of the principal matter; grind it with oil of spike, and it will make a good purple.

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[*] *Crystal* means crystal glass, which is usually kept in powder, fit for use, by enamellers. *Ed.*

A good Red Enamel Colour.

TAKE green vitriol; put it into a copper cup; hold it over a fire, and stir it with a copper wire until it is reduced to a powder; burn this upon a hot tile, on which let it cool of itself; then wash it with rain water, and when settled, pour off that, and put fresh water on, and thus repeat it several times*.

But some artists, instead of washing this powder, boil it in fair water, and think this method better than that of washing. With this powder you may tinge the principal matter to what height you would have your colour. *Or*,

Melt vitriol in a crucible, with a cover, and burn over a gentle fire; when thus you have burned it to a powder, boil it in clean water; filter and dry it: of this take one part, of the principal powder three parts, and of transparent yellow one and one-eighth part. *Or*,

Put vitriol into a crucible, pour a little aqua-fortis upon it, and neal it gently; then put it in a clean earthen pipkin, pour clean water upon it, and boil it one hour; then pour off that, and put fresh water upon it; wash it, and when settled dry it; neal it once more, and it is fit for use.

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* This, and some others are, in reality, the same thing with Colcothar of vitriol; so are the following, with a little variation, viz. scarlet ochre, Spanish brown, Indian red, Venetian red. *Ed.*

Of this powder take two parts, and of the principal powder, or flux, three parts.

A Flux for Red Enamel.

TAKE of red lead four ounces, white scouring sand one ounce; melt it, and pour it into an iron mortar.

Some General Observations.

BEFORE we proceed to another subject, we will conclude this article with a few observations and general rules, for the more easy apprehending of what has been said already.

Observe that gold is the most proper metal to enamel upon; that every colour, except a violet or purple, receives an additional beauty from it, to what it does from silver or copper: that it is best to enrich gold with such beautiful colours, since they raise admiration in the beholder when the skilful artist places them in due order.

The ancients only painted in black and white, with something of a carnation, or flesh colour; in process of time they indeed made some few improvements, but all their enamel colours were equally alike on gold, silver, or copper, every one transparent; and every colour wrought by itself. But since the modern artists have found out a way of enamelling with opaque colours, and of compounding them in such a manner as to shade or heighten the painting in the same manner as is done in miniature, or oil-painting, this art has gained the pre-eminence in small portraits, having the advantage of a natural and lasting lustre, which is never tarnished, nor subject to decay.

The purple coloured enamel does best on silver, from which it receives great beauty; so does the ultramarine, azure and green; all other colours, as well clear as opaque, do not suit it; copper suits with all thick enamels, but is unfit for that which is clear.

Make choice of good, hard, and lasting enamel: the soft is commonly full of lead, which is apt to change the colours and make them look sullied and foul; but if you follow the prescriptions, you will meet with no such inconvenience.

Remember, when you lay white enamel on gold, silver, or copper, to dilute it with water of quince-kernels, as has been directed: clean enamel colours, mix only with fair water; and the opaque, when mixed with flux, or the principal matter, dilute with oil of spike.

Be careful not to keep your work too long in the furnace, but take it often out, to see when it has the proper glazing; and then it is finished.

Before you use your enamels, grind as much as you have occasion for, with fair water, in an agate mortar; thus do with all your clear and transparent enamels, and by this means you will have all things in readiness to proceed in your work with pleasure.

All opaque colours that will stand the fire, are fit to be used in painting enamel. The ingenious artist will not be at a loss, but will meet probably with several colours not yet discovered, as frequently happens to those who try experiments.

OF ARTIFICIAL PEARLS.

It will not be improper to treat in this place of artificial pearls, as it is a branch of jewellery.

The ancients who wrote on the several sorts of precious stones, ranged pearls among the jewels of the first class: they have at all times been in high esteem, and have been employed particularly in adorning the fair sex.

The oriental pearls are the finest, on account of their size, colour, and beauty, being of a silver white; whereas, the occidental or western pearls seldom exceed the colour of milk. The best pearls are brought from the Persian Gulf, above the isles of Ormus and Bassora[*]. They are found in Europe, both in salt and fresh waters; Scotland, Silesia, Bohemia, and Frisia[†], produce very fine ones: though those of the latter country are very small.

Art, which is always busy to mimic nature, has not been idle to bring counterfeit pearls to the greatest perfection: they are imitated so near, that the naked eye cannot distinguish them from pearls of the first class, or the real ones.

We shall here present the curious with several receipts how to counterfeit pearls in the best manner, and after a method both easy and satisfactory, so as to render his labour pleasant, and make it answer his expectations.

To imitate fine Oriental Pearls.

Take of distilled vinegar two pounds, Venice turpentine one pound; mix them together into a mass, and put them into a cucurbit; fit a head and receiver to it, and, after you have luted the joints, set it, when dry, on a sand furnace, to distil the vinegar from it; do not give it too much heat, lest the stuff should swell up.

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[*] Called also *Balsora* and *Basrah*. *Ed.*

[†] That part of Germany lying between the Rhine and the Ems. *Ed.*

After this, put the vinegar into another glass cucurbit, in which there is a quantity of seed pearl, wrapt in a piece of thin silk, but so as not to touch the vinegar; put a cover or head upon the cucurbit; lute it well, and put it in *Bal. Mariæ* [*], where you may let it remain a fortnight. The heat of the *Balneum* will raise the fumes of the vinegar, and they will soften the pearls in the silk, and bring them to the consistence of a paste; which being done, take them out, and mould them to what bigness, shape, and form you please. Your mould should be of fine silver, the inside gilt; you must refrain from touching the paste with your fingers, but use silver gilt utensils, with which fill your moulds; when you have moulded them, bore them through with a hog's bristle, or gold wire, and let them dry a little; then thread them again on a gold wire, and put them in a glass; close it up, and set them in the sun to dry; after they are thoroughly dry, put them into a glass matrass in a stream of running water, and leave them there twenty days; by that time they will contract the natural hardness and solidity of pearls. Then take them out of the matrass, and hang them in *mercury-water* [†], where they will moisten, swell, and assume their oriental beauty; after which shift them into a matrass, hermetically closed up, to prevent any water coming to them, and let it down into a well, to continue there about eight days; then draw the matrass up, and on opening it you will find pearls exactly resembling oriental ones. This method is very excellent, and well worth the trouble.

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[*] Balneum Mariæ, sometimes called Balneum Maris, is a bath of sand, heated by a fire, in which chemical apparatus are plunged, to submit their contents to a digestive heat. *Ed.*

[†] *Mercury-water*, so called by the workmen, is thus prepared. Take plate-tin of Cornwall; calcine it, and let the calx be pure and fine; then with one ounce of the calx, and two ounces of pure mercury, make an amalgam; wash it with fair water, till the water remains insipid and clear; then dry the amalgam thoroughly; put it into a matrass, on a sand bath, giving it such a heat as is requisite for sublimation. When the matter is well sublimated, take off the matrass, and let it cool. Take out that sublimate; add one ounce of Venice sublimate to it, and grind it together on a marble;

Another Way to make Artificial Pearls.

TAKE oriental seed-pearls; reduce them into a fine powder, on a marble; then dissolve them in mercury-water, or clarified juice of lemons. To make more dispatch, set them in a cucurbit, in bal. mar. and you will see presently a cream arise at the top, which take off immediately: take the solution off the fire, and, when settled, pour off the liquid into another glass, and save it. You will have the pearl paste at the bottom, with which fill your silver-gilt moulds; then put them by for twenty-four hours: bore them through with a bristle, close up the moulds, in barley dough, and put it in an oven to bake, and when about half baked, draw it out, take out your pearls, and steep them in the liquor you saved before, putting them in and taking them out several times: then close them up in their moulds, and bake them again with the like dough; but let it remain in the oven till it is almost burnt, before you draw it out. After you have taken your pearls out of their moulds, string them on one or

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put this into another matrass; close it well, and set it upside down in a pail of water; and the whole mass will dissolve in a little time: this done, filter it into a glass receiver; set it on a gentle sand heat to coagulate, and it will turn into a crystalline substance: this beat in a glass mortar, with a glass pestle, to a fine powder; sift it through a fine sieve, and put it into a matrass; stop it close up, and place it in *baln. mariæ*; there let it remain till it resolves again into water; which is *the mercury-water*, fit for the above-mentioned use.

more gold or silver threads, and steep them in mercury-water for about a fortnight; after which time, take and dry them in the sun, in a well-closed glass, and you will have very fine and bright pearls.

Another Way.

DISSOLVE very fine pulverised oriental pearls in alum-water; when the solution is settled, pour off the water, and wash the paste first in distilled water, then in bean water, and afterwards set it in *bal. mariæ*, or horse-dung, to digest for a fortnight, this done, take out your glass, and the matter being come to the consistence of a paste, mould it as you have been directed before; bore and string the pearls on a silver thread, and hang them in a well-closed glass alembic, to prevent the air coming to them: thus dried, wrap every one up in leaves of silver; then split a barbel, and close them up in the belly thereof; make a dough of barley meal, and bake the fish, as you do bread; then draw him, take out your pearls, and dry them in a closed glass in the sun.

To give them a transparency and splendor, dip them in mercury-water; or, instead, take the herb *gratuli*[*], and squeeze it in water; put therein six ounces of seed-pearl, one ounce of nitre, one ounce of roach alum, one ounce of litharge; the whole being dissolved, heat first the pearls, and then dip them in this solution to cool; repeat this about six times successively.

If your pearls should not have their natural hardness, then take two ounces of *lapis calaminaris* in impalpable powder; add to this two ounces of acid of vitriol, and two ounces of whites of eggs beaten into a water; put them together into a retort; lute a receiver to it, and you will distil a fair water, with which, and some fine barley flour, make a paste, in which put your pearls, and bake them as before; thus they will become exceedingly hard.

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[*] Probably *gratiola*, i. e. *hedge-hyssop*, is here meant by the unknown term *gratuli*. *Ed.*

Another Method.

TAKE chalk well purified and cleansed from all grossness and sand, *i. e.* whiten; of this make a paste, and form pearls, in a mould for that purpose; pierce them through with a bristle, and let them dry in the sun or in an oven; then string them on a silver thread; colour them lightly over with *Armenian* bole, diluted in the white of eggs; and when dry, drench them with a pencil and fair water; lay them over with leaf silver, and put them under a glass in the sun to dry; when dry, polish them with a dog's tooth.

To give them the true colour, make a glue of vellum shavings, thus: after you have washed them in warm water, boil them in fair water, in a new earthen pot or pipkin, to some thickness, and then strain them through a cloth. When you would use it, warm it first, and dip your string of pearls into it, but let there be an interval between each pearl, so as not to touch one another; this will give your pearls a natural lustre.

To form large Pearls out of small ones, as directed by Korndorffer.

TAKE of mercurial water fourteen ounces; put two ounces of *sulph. solis* *, into a low matrass, pour the mercurial water upon it, and let it dissolve and extract. Then take of the whitest small pearls twenty ounces, put them into a proper matrass, and pour the said water upon it.

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* *Sulphur Solis* may probably mean a preparation of silver, not now in use. *Ed.*

The pearls will by degrees dissolve, and at last turn to a clear calx, much like dissolved silver calx: pour off the mercurial water; boil the calx well out, and dry it; then put it into a clean crucible by itself, and melt and cast it into what form you please. When cold, polish it in the same manner as you do gems or crystals; and you will have your work of the consistence and beauty of the finest and clearest oriental pearl.

To make of small Pearls a fine Necklace of large ones.

TAKE small oriental pearls, as many as you will; put them into mercurial water fifteen days and nights together, and they will turn soft, like a paste; then have a pearl mould, made of silver; into this convey the paste by a silver spatula, or such like implement; but you must not touch the paste with your fingers, and be very careful to have every thing nice and clean about this work: when it is in the mould, let it dry; bore a hole with a silver wire through it, and let it stick there till you have more, but take care they do not touch one another; then have a glass wherein you may fix, as upon a pair of stands, your wires with the pearls: put them, well closed up, in the sun to harden, and when you find them hard enough, put them into a matrass; lute the neck very close, and sink it in a running spring of water for twenty days, in which time they will contract their natural colour.

It is asserted, by those who have wearied themselves with the hopes of forming small imperfect pearls into larger ones, that artificial pearls cannot be made of the materials of original pearls. The foregoing receipts are laborious and expensive; and that the reader may have some reward for his exertions, should the experiments balk his expectations, we shall add to this edition a tried and approved method of imitating pearls from other materials, which, when well executed, can only be distinguished from the real by their absolutely containing *fewer blemishes.* The method was kept a profound secret for many years.

Best Method of imitating Pearls.

TAKE the *blay* or *bleak-fish*, which is very common in the rivers near London, and scrape off, in a delicate way, the fine silvery scales from the belly. Wash and rub these in fair water, changing the water, and permitting the several liquors to settle: the water being carefully poured off, the pearly matter will be found at the bottom, of an oily consistence, called by the French *essence d'orient*. A little of this essence is dropped into a little hollow glass bead of a bluish tinge, and shaken about, so as to fill up all the cavities and surface of the internal part. When the essence is thoroughly dry, melted white wax is dropped into the beads, to give them weight, solidity, and security.

To clean Pearls when of a foul Colour.

TAKE pigeon's dung; moisten it with alum-water, to the consistence of a paste: put this into a glass, big enough to hold four times the quantity, put into this your yellow-coloured or foul pearls, so that they may be covered all over, and set them in a warm place, or behind an oven; let them stand for a month; then take them out, and fling them into fresh cold alum-water, and dry them carefully, and your pearls will become fine and white: if you repeat the operation once or twice, they will be done to greater perfection.

To blanch and cleanse Pearls.

FIRST soak and cleanse them in bran-water; then in milk-warm water, and last of all, steep them in mercury-water: then string and hang them in a glass; close it well, and set them in the sun to dry.

The bran water is made thus: boil two large handfuls of wheaten bran in a quart of water, till all the strength of the bran is drawn out: use it thus; take a new glazed earthen pan, in which put your pearls on a string, and pour the third part of the bran-water upon it; when they have soaked, and the water is just warm, rub your pearls gently with your hands, to clean them the better; continue this until the water is cold; then throw off that, and pour on another third part of the bran water that is boiling; proceed with this as you did before, and when cold throw it away, and pour on the remainder of the water, still proceeding as before; after this, heat fair water, and pour it on your pearls, to refresh them, and to wash away the remains of the bran, by shifting them, and pouring on fresh warm water: this do thrice, without handling your pearls; then lay them on a sheet of clean white paper; and dry them in the shade; then dip them into mercury water, to bring them to perfection.

Other Methods used in blanching Pearls.

POUND plaster of Paris to an impalable powder; rub the pearls therewith very gently; this will not only cleanse them, but if you let them remain in this powder twenty-four hours afterwards, they will still be the better for it. White coral has the same effect, used in the like manner.

White tartar calcined and divested of all its moisture, is for the same purpose.

Salt, well dried and ground, is as effectual as any of the former things, for cleansing of pearls, by rubbing them therewith; and if afterwards you lay them up in some ground millet, it will contribute to their natural brightness.

OF DOUBLETS.

A Doublet, among lapidaries, implies a counterfeit stone composed of *two* pieces of crystal, with proper colours between them; so that they may make the same appearance to the eye as if the whole substance of the crystal had been tinged with these colours.

The impracticability of imparting tinges to the body of genuine natural crystals, without depriving them of their brilliancy, gave inducements to the introduction of colouring the surface of them, so as to give them, when finished, the appearance of a gem. They have not the property which artificial stones have of being set transparent, as is required for drops of earings, &c. but they suit very well for rings, and other ornaments which allow of an opaque back-ground. They are made after the following manner:

A crystal, or glass in imitation of crystal, is to be cut by a lapidary into the shape of the precious stone it is to resemble; a brilliant, for instance, must be composed of two separate stones, or two parts of one stone, forming the upper and under parts of the brilliant, dividing the whole stone in a horizontal plane, a little lower than the middle. No division appearing between the two pieces when duly polished and placed on one another, the colour of the intended stone is put between them, after the following method:

Take of Venice or Cyprus turpentine two scruples, and add to it one scruple of the grains of mastich, chosen perfectly pure, free from foulness, and previously powdered. Melt them together in a small silver or brass spoon ladle, and put to them some one of the colouring substances mentioned hereafter, they being also finely powdered: stir them together as the colour is put in, that they may be thoroughly commixed. Warm then the doublets to the same degree of heat as the melted mixture, and paint the upper surface of the lower part, putting the upper one instantly upon it; and press them to each other, taking care that they are conjoined in the most perfectly even manner. When the paint or cement is quite cold and set, scrape off the redundant part of it which has been pressed out of the joint, so as to leave no colour on the outside of the doublet. They should be so set as skilfully to carry the mointing just above the joint, which will hide the artifice and secure the pieces from separating.

As the proportions vary in the receipt given in the former editions of this work, we shall here insert it, lest it be thought, on trial, to have the preference: it is as follows—

Method of making Doublets.

TAKE two drachms of clear mastich, and of the clearest Venetian or Cyprian turpentine sixteen drams; dissolve these together in a silver or brass spoon: if you find there is too much turpentine, then add a little more mastich to it, to bring it to a right temper. Then take what colour you please, as lake, dragon's blood, distilled verdigrise, or what colour else you design, for representing a particular stone; grind each by itself, in the nicest manner you possibly can, and mix each apart with the mixture of mastich and turpentine, which you ought to have ready by you; and you will find the lake to imitate the colour of a ruby, the dragon's blood that of a hyacinth, and the verdigrise the colour of an emerald. But in case you would have your colours, as it were, distilled, then get a little box, made of lime-tree, in the shape of an egg or acorn. This box must be turned at the bottom as thin as possible, so that the light may be seen through it. Then make a quantity of any one of the abovesaid colours, mixed with the mixture of mastich and turpentine, and put it into the little box, hung over a gentle glowing coal fire, or in summer-time in the heat of the sun, where the colour will distil through very fine; scrape and put this into little boxes of ivory, to preserve it from dust, for your use; it is necessary to have to every different colour such a different wooden box.

When the colours are ready, take your crystals (first ground exactly to fit upon one another) and make your colours and stone of an equal warmth; lay your colour with a fine hair pencil on the sides of the crystals that are to be joined together; then clap them against each other as nimbly as possible: press them with your fingers close together; let them cool, and it is done.

The colour of the *Ruby* is thought by some ingenious artists to be best imitated by a fourth part of carmine, with some of the finest crimson lake that can be procured.

The *Sapphire* may be counterfeited by very high Prussian blue, mixed with a little of the above-mentioned crimson lake, to give it a tinge of the purple hue. Let not the Prussian blue be too deep coloured, or you must use the less of it, otherwise it will give a black shade which will obscure the brilliancy of the doublet.

The *Emerald* may be well imitated by distilled verdigrise, with a small portion of powdered aloes. But the mixture should not be strongly heated, nor kept over the fire after the verdigrise is added, for the colour is impaired by it.

The resemblance of the *Garnet* may be made by dragon's blood; which, if it cannot be procured of sufficient brightness, may be helped by a small quantity of carmine.

The *Amethyst* is imitated by the mixture of some Prussian blue with crimson lake; but the proportions can only be regulated by experience, as the parcels of blue and lake vary so much in their hues, and are of such different strengths of colours.

The *Yellow Topaz* may be counterfeited by mixing powdered aloes with a little dragon's blood, or by good Spanish anotto; but the colour must be sparingly used, or the colour will exceed that of the stone.

The *Chrysolite*, *Hyacinth*, *Vinegar Garnet*, *Eagle Marine*, and other such weak and diluted colours, may be formed and imitated in like manner, only with less proportions of the due colours; for which purpose, those who employ their ingenuity and leisure hours in this pursuit, should obtain an original stone of each of those specified, keeping his eye perpetually watchful whilst mixing the colours. When these precautions are taken, and the operation is well conducted, it is practicable to bring the doublets to so near a resemblance of the true stones, as to deceive the best judges (when they are well set, and the joint hid) unless inspected in one direction only. The direction alluded to is, to hold them betwixt the light and the eye, so that the light may pass through the upper part and corners of the stone; when it will be readily perceived whether there be any colour in the crystal; which cannot be learned by looking down upon the doublet.

The Crystal Glue of Milan.

This is nothing else but grains of mastich, squeezed out of a linen bag by degrees over a charcoal fire, and like clear turpentine. Its use is, to unite two pieces of crystal together, to form a doublet, precisely in the manner before described.

INSTRUCTIONS CONCERNING FOILS, OR METALLIC LEAVES, WHICH ARE LAID UNDER PRECIOUS STONES.

It is customary to place thin foils, or leaves of metal under precious stones, to make them look transparent, and to give them an agreeable colour, either deep or pale: thus, if you want a stone to be of a pale colour, put a foil of that colour under it; again, if you would have it deep, lay a dark one under it: besides, as the transparency of gems discovers the bottom of the ring they are set in, artificers have found out these means to give the stone an additional beauty.

These foils are made either of copper, or gold, ~~or~~ gold and silver together: we shall first mention those made of copper only, which are generally known by the name of *Naremburg* or *German* foils.

Procure the thinnest copper plates you can, the thinner they are the less trouble they will give you in reducing them to a finer substance: beat these plates gently upon a well polished anvil, with a polished hammer, as thin as possible; but before you go about this work, take two iron plates, about six inches long, and as wide, but no thicker than writing-paper; bend them so as to fit one on the other; between these neal the copper you design to hammer for the foils, to prevent ashes, or other impurities getting to it; then, taking them out, shake the ashes from them, and hammer the copper until cool. Then take your foils to the anvil, and beat them until they become very thin, and whilst you beat one number, put in another between the irons to neal; this you may repeat eight times, until they are as thin as the work requires. You must have a pipkin with water at hand, in which put tartar and salt, of each an equal quantity; boil, and put the foils in, and stir them continually, until, by boiling, they become white: then take them from the fire; wash them in clean water;

dry them with a clean fine rag, and give them another hammering on the the anvil, until they are fit for your purpose.

N. B. Care must be taken in the management of this work, not to give the foils too much heat, to prevent their melting; neither must they be too long boiled, for fear of attracting too much salt.

How to polish and colour Foils.

TAKE a plate of the best copper, one foot long, and about five or six inches wide, polished to the greatest perfection: bend this to a convex shape, lengthwise, and fix it to a bench, or table: then take some whiten, and having laid some on the roll, and wetted the copper all over, lay your foils upon it, and with a polish-stone and the whiten, polish your foils, until they are as bright as a looking-glass; then dry them between a fine rag, and lay them up secure from dust. I shall now shew how these foils are coloured; but shall first give a short description of the oven, or furnace, requisite for that purpose.

The furnace must be but small and round (see plate 4, and the explanation) about a foot high, and as wide; cover the same with a round iron plate, in which is a round hole, about four inches wide; upon this furnace put another without a bottom, of the same dimension as the former, and let the crevices of the sides round about be well closed and luted: this furnace must also have a hole at top. The lower furnace must have a little door at bottom, about five inches big. Before this fix a sort of funnel, like a smoke-funnel to an oven, and lute it close to the furnace; then light some charcoal on your hearth, and when they burn clear, and free from smoke, convey them through the funnel into the furnace, till they come up so high as to fill half the funnel. When every thing is ready, and you have a clear fire, then begin to colour your foils in the following manner:

Lay the foils upon a pair of iron tongs; hold them over the hole that is at top of the furnace, so that the fumes of the coals may reverberate over them, and move them about till they are of a brownish violet colour; and this is done without any other vapour or smoke. When you have done with this colour, put it by, and if you would colour others of a sky blue, then put the foils upon the tongs as before; and whilst you, with one hand, are holding the foils over the holes, fling, with the other, some down-feathers of a goose, upon the live coals in the funnel, and with a red-hot poker press them down, to drive the smoke of the feathers up through the holes of the oven, which, by settling upon the foils, gives them a fine sky colour: but you must have your eyes very quick upon them, and, as soon as you see that they have attracted the colour you design, take them away from the oven, to prevent their changing to some other colour: if you would have your foils of a sapphire blue, then first silver them over; which is done in this manner:

Take a little silver and dissolve it in aqua-fortis; when dissolved, put spring water to it; fling thin bits of copper into it, and the water will look troubled, and the silver precipitate and hang to the copper; pour off that, sweeten the silver with fair water, and let it dry in the sun; when dry, grind it on a porphyry: then take one ounce of tartar, and as much of common salt; mix and grind them all together, till they are well mixed; fling this powder upon the thin foils, and rub them with your finger backwards and forwards, and it will silver them, then lay them upon the polisher, pour water over them, and some of the powder, and rub it with your thumb till they are as white as you would have them: polish them with a polisher of blood stone; and then holding them over the goose-feather smoke, they will take a fine dark blue.

To

To colour Foils of a Green Colour, for an Emerald.

YOU must first colour your foils of a sky blue, as directed before; then hold them over the smoke-hole, and below, in the funnel, lay, upon the red-hot iron plate, leaves of box, from which ascends a smoke that gives the foils a green colour; but before they contract that colour they undergo several changes, as blue, red, and yellow, &c. wherefore you must hold them till you have the green colour to your mind.

To colour the Foils of a Ruby Colour.

PUT the shearings of scarlet cloth upon the coals, and holding the foils over the smoke-hole, they will contract a fine red colour.

The Colour of an Amethyst.

THIS may be obtained by proceeding with your foils as for the blue or sapphire colour; for, before that blue colour comes, it first changes to an amethyst; as soon as you perceive this, take them off, and polish them.

How Foils are to be mixed with Copper and other Metals.

THESE are more difficult to make, but more lasting in their colour. Take one pound and a half of copper, and melt it in a crucible; fling into this two ounces and eleven penny-weights of gold; when in fusion, pour it into a flat ingot, and let it cool: this beat and work, as has been taught, into thin foils; then boil them in tartar and salt. These sort of foils will take a fine ruby colour; nor can that colour be well done without this mixture.

Another Way.

TAKE small-coal dust; put it into a little iron oven, and in the midst thereof a live charcoal; blow it till all the small-coal dust is lighted, and let this glow for two hours: when it is nearly all glown out, add such another quantity to it, and let it glow for an hour. At the top of your oven must be a round or square hole, with a close cover to it, in which hang the foils to some copper or iron wire: when your small-coal has glowed for about an hour, take a little iron bowl, and warm it well; put in it a little quantity of fox hair, and then set it upon the small-coal dust; shut the oven door, and open the top: this will draw the smoke through, and give the foils, first, the colour of a ruby, then of an amethyst, and, lastly, a sapphire. You may take out such colours as will serve your purpose; and if you want a green, let those foils hang, and burn sage leaves till the foils turn to a green colour. Take care to put but a few sage leaves in at a time.

To the ruby and hyacinth-colours use pure copper; but for an emerald and sapphire, take one part of gold, two parts of silver, and eight parts of copper; melt, and work them together.

THE ART OF IMITATING PRECIOUS STONES, OR OF MAKING ARTIFICIAL GEMS.

THIS curious art is arrived at such perfection, as to be capable of imitating precious stones in their lustre, colour, and beauty, equal to the natural ones, except in hardness, to obtain which has been, and no doubt still is, the endeavour of ingenious men.

The art of making artificial gems, consists chiefly in rightly imitating the tints of those that are real: these must be prepared from such things as resist the fire, and do not change their colour.

You must therefore take such colours as change not, when mixt together: therefore, since blue and yellow make a green, you must take such blue as shall not hurt the yellow when you mix them; and also such a yellow as shall not be detrimental to the blue; and so of the other colours. We shall give plain instructions to carry the ingenious artist with ease through his experiments.

The Way of preparing Natural Crystal.

Take natural crystal, the clearest you can get, no matter how big the pieces are; fill a large crucible with them, and cover it with a lid broader than the mouth of the crucible, to prevent the falling of ashes or coals into it: then put it into a small furnace, on burning coke: and when the crystal is thorough hot, cast it into a pretty large vessel of cold water. Then take it out of the water, dry it on an earthen plate, and put it into the same crucible again, cover it, and proceed as before, repeating it twelve times running, and changing each time the water: when the crystal easily breaks and crumbles, and is thoroughly white, it is a sign that it is calcined enough: if there appear any black parts in the veins, break off the white, and put these again into the furnace, and proceed therewith as before, till only the white remain behind.

After you have dried this calcined crystal thoroughly, grind it to an impalpable powder, on a marble or porphyry, and sift it through a lawn sieve. Of this powder of crystal, as it is used for all artificial gems of which we shall treat, it will be proper to have a sufficient quantity by you, to have recourse to when at work; and if you would succeed in this art, you must not use ordinary frit of crystal, be it ever so good; for that will not answer, or come up to the lustre or beauty of natural crystal.

To counterfeit an Opal.

At Harlem they make counterfeit opal glass, which is very lively, and whose several colours are supposed to be produced by different degrees of heat. When the composition is thoroughly melted, some of it, taken out on the point of an iron rod, being cooled, either in the air or water, is colourless and pellucid, but being put again into the mouth of the furnace upon the same rod, and turned round for a little time, acquires such various positions, as that the light falling on them being variously modified, represents the several colours observable in the true opal. And it is remarkable that these colours may be destroyed and restored again by different degrees of heat.

To make a fair Emerald.

TAKE of natural crystal four ounces, of red-lead four ounces, verdigrise forty-eight grains, crocus martis, prepared with vinegar, eight grains; let the whole be finely pulverized and sifted: put this together in a crucible, leaving one inch empty; lute it well, and put it into a potter's furnace, where they bake their earthen ware, and let it stand there as long as they do their pots. When cold, break the crucible, and you will find a matter of a fine emerald colour, which, after it is cut and set in gold, will equal in beauty an oriental emerald. If you find that your matter is not refined or purified enough, put it again, the second time, in the same furnace, and in lifting off the cover you will see the matter shining; you may then break the crucible, but not before; for if you should put the matter into another crucible, the paste would be cloudy and full of blisters. If you cannot come to a potter's furnace;

furnace, you may build one yourself at a small expence*, in which you may put twenty crucibles at once, each with a different colour, and one baking will produce a great variety of artificial gems. Heat your furnace with hard and dry wood, and keep your matter in fusion twenty-four hours, which time it will require to be thoroughly purified; and if you let it stand four or six hours longer, it will not be the worse for it.

A deeper Emerald.

TAKE one ounce of natural crystal, six ounces and a half of red lead, seventy-five grains of verdigrise, ten grains of crocus martis, made with vinegar: proceed as directed before. *Or,*

Take prepared crystal two ounces, red led seven ounces, verdigrise eighteen grains, crocus martis ten grains, and proceed as before directed.

To make a Paste for imitating an Oriental Topaz.

THE colour of this stone is like water tinged with saffron or rhubarb: to imitate it, take of prepared natural crystal one ounce, of red lead seven ounces, finely powdered and sifted; mix the whole well together, and put it into a crucible, not quite full by an inch, lest the matter should run over, or stick to the cover of the crucible in rising; then proceed as directed above. *Or,*

Take prepared crystal two ounces, native cinnabar two ounces; *æs ustum* two ounces (all finely pulverized and sifted), four times as much calcined tin; put it all together into a crucible well covered, and proceed as before.

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* The reverberating furnace, which belongs to the common portable furnaces, will do for one crucible at a time. *Ed.*

To make an Artificial Chrysolite.

THIS stone is of a green colour, and some have the cast of gold; to imitate it, take natural crystal prepared two ounces, red lead eight ounces, crocus martis twelve grains; mix the whole finely together, and proceed as before, only leaving it a little longer than ordinary in the furnace.

To counterfeit a Beryl, or Aqua Marina.

THIS stone is of a bluish sea-green: to imitate it, take two ounces of natural crystal prepared, five ounces of red lead, twenty-one grains of zaffre prepared (the whole finely pulverized); put them in a crucible, and cover and lute it; then proceed as directed above, and you will have a beautiful colour.

A Sapphire Colour.

A SAPPHIRE is generally of a very clear sky-colour, and is highly esteemed for its beauty. There are some of a whitish colour, like diamonds; others, of a full blue; and some, of a violet.

To make this paste, take of prepared rock-crystal two ounces, red lead four ounces and a half, smalt twenty-six grains; pulverize and proceed as directed. This colour will come near to a violet.

Another, more beautiful, and nearer the Oriental.

TAKE two ounces of natural crystal prepared, six ounces of red lead, two scruples of prepared zaffre, and six grains of prepared manganese, (all reduced to a fine powder); mix, and proceed as before.

Another, deeper coloured Sapphire.

Of prepared natural crystal take two ounces, red lead five ounces, prepared zaffre 42 grains, prepared manganese eight grains; the whole reduced to an impalpable powder, and mixed together; proceed as you have been directed, and you will have a colour deeper than the former, tending to a violet.

To make a Paste for an Oriental Garnet.

A GARNET is much like a carbuncle; both, if exposed to the sun, exhibit a colour like burning coals, between red and yellow; and this is the true colour of fire. To imitate this stone, take two ounces of natural crystal prepared, and six ounces of red lead, also 16 grains of prepared manganese, and two grains of prepared zaffre, pulverize and mix the whole; put it into a crucible, and proceed as directed.

Another, deeper Garnet.

Of natural crystal prepared, take two ounces, red lead five ounces and a half, prepared manganese 15 grains; pulverize all, and proceed as before directed.

ANOTHER PROCESS FOR COUNTERFEITING OF PRECIOUS STONES.

Take of black flint stones what quantity you please; put them into a pail of hot water, and, being wet, put them into a hot furnace, (this will prevent their flying into small pieces ;) or else warm them thoroughly by degrees, before you put them into the furnace. When you see that they are thoroughly red hot, quench them in fair water, and they will look of a fine white colour, dry and pulverize them very fine ; this you may do in an iron mortar, but, as the powder may contract some of the iron, it will be proper, after you have taken it out, to pour on it some muriatic acid, which will clear it of the iron, and disengage it from impurities : wash it in several clear hot waters, afterwards.

Powder, thus prepared, is fit to be used for making the finest glass, and for imitating the clearest and most transparent gems, especially those that require the lustre of a diamond or ruby : as for a sapphire, emerald, topaz, chrysolite, amethyst, &c. your labour with the acid may be saved, if your mortar be bright and free from rust. Such as have a mortar of porphyry, or such like stone, have no occasion to use an iron one, but will save themselves a great deal of trouble.

If you cannot get black flint stones, you may content yourself with pebble ; but flint is far preferable, and makes the glass of a harder substance than that made of pebble.

An approved Composition.

Of the above flint powder take three parts, refined nitre two parts, borax and arsenic one part. *Or*,

Of the flint powder three parts, nitre two, and borax four parts. *Or*,

Of the flint powder two parts, of refined pot-ash, or salt of tartar and borax, of each one part. *Or*,

Take of flint powder seven parts and a half, purified potash five parts. *Or*,

Flint powder six parts and an half; nitre two and a half; borax one half; arsenic one half; and tartar one part.

To melt these Compositions; and how to tinge and finish your Work.

TAKE any one of the above specified compositions, and weigh what quantity you please, (one or two ounces); then mix it with the colour you design to have it of; for instance,

To make a Sapphire.

TAKE, to one ounce of the composition, four grains of zaffre; mix well together, and melt in a crucible; if you find the colour to your liking, proceed to finish it. You may make a sapphire either deeper or paler, according to what quantity you take of each ingredient; and it is the same with respect to other colours. A new practitioner in this art may make experiments in small crucibles, in order to acquaint himself with the nature of it.

I have already given receipts of most colours for imitating precious stones; but, nevertheless, I shall here lay down some experimental rules necessary to be observed.

Know then that crocus martis may be prepared different ways, and each will have a particular effect in colouring of crystals; one is prepared with vinegar, another with sulphur, a third with aqua-fortis, and a fourth by only a reverberatory fire.

To prepare Crocus Martis with Vinegar.

TAKE iron, or, which is better, steel filings; moisten and mix them up with good strong vinegar, in an earthen dish, or pan; after which, spread them, and let them dry in the sun; when dry, beat them fine in a mortar; moisten this powder with fresh vinegar, and dry and beat it again, as before; repeat this eight times running; afterwards, dry and sift it through a fine hair sieve, and it will be of the colour of brick-dust; but when mixt with glass, of a fine crimson colour. Put this powder up carefully, to preserve it from dust.

To prepare Crocus Martis with Sulphur.

Take iron, or steel filings, one part; sulphur three parts; mix them together, and put them into a crucible; cover and lute it well; then set it into a wind-furnace, and give it a strong fire, with charcoal, for four hours together; then shake it out, and, when cold, pulverize and sift it through a fine sieve: this powder put into a crucible, lute it, and place the same in the eye, or hole, of a glass furnace; let it stand there for fourteen days or more, and it will turn to a red powder, inclining to purple: this is a very useful ingredient for tinging of glass.

To prepare Crocus Martis with Aqua-Fortis.

Moisten some iron, or steel filings, in a glazed earthen plate, or dish, with aqua-fortis; set it to dry in the sun, or air; when dry, grind it to a fine powder; moisten it again with fresh aqua-fortis; dry it, and proceed as before, repeating it several times, till you see it of a high red colour; then grind and sift it through a fine hair sieve, and lay it up safe from dust.

To prepare Crocus Martis by a reverberatory Fire.

Take clean iron, or steel filings, and put it into a large pot, or pan, about the quantity of an inch high; cover it well, and put it into a reverberatory furnace, or any other place where it may be surrounded with a strong heat and flame; the iron will swell and rise in a fine red powder, so as to fill the pot, and even force up the lid; take off this powder, and you will find a good quantity of iron, caked together at the bottom, which put again into the furnace, where it will swell and rise into a powder as before; this continue until you have a sufficient quantity. This is the most valuable crocus, and of great use in the art of colouring or tinging of glass for counterfeiting of precious stones.

To make a fine Hyacinth.

Take of crocus martis, or of that iron powder prepared by reverberation, eight or ten grains to one ounce of the composition.

The Opal.

This is made of silver dissolved in aqua-fortis, precipitated by common salt; add to it some load-stone, and mix it up with the above composition: it gives divers colours, so as to represent a natural opal.

Of Chrystal.

Such as will save themselves the trouble of preparing the composition for counterfeiting precious stones, may use fine crystal or *Venice* glass, beat in a clean mortar to a fine powder; of this take eight ounces, borax two ounces, refined nitre one ounce; which mixture you may melt and colour, with little trouble.

Bartholomew Korndorfer's *Secret to make a Diamond of a natural Crystal.*

Take the best polished crystal, no matter whether large or small, so it is but clear and transparent; put it in a crucible, with three times as much of my fixed sulphur of gold, so that the crystal may be covered all over with it; then, after you have put a lid over it, and luted the crucible well, let it for three days and nights neal in a strong fire; then take it out and quench it in spring water, in which red hot steel is quenched forty-six times running, and you will have a diamond which resembles a natural one in every respect, and is right and good.

Thus far *Korndörffer*, but as to his *sulphur* he has left us in the dark.

How to make a Diamond out of a Sapphire, according to PORTA'S *Description.*

WE used to make it, (the diamond) the surest way, in this manner: we filled an earthen pipkin, or crucible, with quick-lime, and laid the sapphire in the midst thereof, covering it first with a tile, and then with coals all over, blowing them gently until we had a clear fire; for if it is blown too much, it may occasion the breaking of the stone.

When we thought that the sapphire had changed its colour, we let the fire go out of itself, and took it out to see whether it was turned white; if so, then we laid it again in the crucible, in order to let it cool with the fire; but if it had not the right colour, then we augmented the heat again as before, and looked often to see whether the force of the fire had taken away all the colour, which was done in about five or six hours; if then the blue colour was not quite gone, we began our operation afresh, until it was white and clear. It is to be observed, that the heat of the fire, in the beginning of the operation, must increase by slow degrees, and also in the same manner decrease; for if the stone comes either too suddenly into the heat, or from the heat into the cold, it is apt to turn dark, or fly to pieces.

In like manner all other precious stones lose their colour, some sooner than others, according as they are either harder or softer. The amethyst is very light, and requires but a slow fire, for if it has too much heat, it becomes dark, or turns to a chalky appearance.

This is the art whereby inferior precious stones are changed into diamonds; they are afterwards cut in the middle, and a colour given them; and hence become a second sort of false diamonds, or doublets.

To make a fine Amethyst.

TAKE calcined flint-stone, and sift it through cambric, whereof take three quarters of an ounce; of fixed nitre, one quarter of an ounce; of borax three quarters of an ounce; manganese one quarter of an ounce: then add fixed* nitre and borax, well mixed, to it; put it in a crucible into a wind furnace; give it at first a gentle heat until it is red hot, and thus keep it for a quarter of an hour; then give it a strong fire for two or three hours; at last pour it into a mould, and let it cool by degrees, to prevent its flying asunder.

To make a Ruby, or a fine Hyacinth.

TAKE acid of vitriol one ounce, and mix with the same weight of water; in this dissolve filings, or very thin beaten steel; set the glass on warm sand; filtrate the solution before it is cold; then set it in a cellar, and it will shoot into crystals, which pulverize; put it under a muffle, and stir it until you see it of a crimson colour; then take it off the fire, put it in a phial, pour on it good distilled vinegar, and after it has stood four days in a gentle warmth, pour off that vinegar, and pour fresh to it, and let it stand four days more; this repeat until the vinegar is observed to make no extraction; then pour off the vinegar, and there will remain at the bottom of your phial a crimson-coloured powder; sweeten this well with warm water. This is the tincture-powder for the ruby or hyacinth†.

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* *Fixed nitre* is no other than purified *pot-ash*, the acid of the nitre being set at liberty by charcoal, in the process of detonation. *Ed.*

Then take black flints; calcine them well, as has been already directed, in order to bring them to a white powder, and sift this through cambric; take thereof, and of borax, of each half an ounce, and of the aforesaid tincture-powder eight or nine grains; and mix well together in a crucible, and give it, for half an hour, a gentle fire: augment it by degrees, until you see your mixture in the crucible as clear as crystal, and of a crimson colour; then pour into a mould of what shape you would have it.

Another Artificial Ruby.

Brasilian topazes, of a smoky appearance, may be artificially made into rubies by giving them a gradual heat in a crucible filled with ashes, till it be red-hot.

To make a Ruby Balass.

Take prepared powdered flint three ounces, fixed nitre, *i. e.* purified pot-ash, one quarter of an ounce; borax three grains; some of the above-mentioned tincture-powder; of copper and iron fifty-four grains; of prepared manganese, five grains; mix all together, and put it into a new crucible; give it, at first, a gentle fire, till it begins to melt; then give it a strong fire, for two hours, and let it cool of itself.

To harden Bohemian *Diamonds.*

Take black lead two ounces, golden talc two ounces, powder it fine, and mix it well together; then take off this mixture, put it into a new crucible, about half full, and place the said diamonds upon that powder, so as not to touch one another; then put of the powder as much upon them as will fill the crucible; cover and lute it, and set it in a cupel with ashes, so as to have the ashes a hand's breadth about the crucible; then give it a slow fire, and augment the heat by degrees, in order to preserve the stones from breaking, until the cupel which holds your crucible begins to be red hot, continue it thus for forty-eight hours, then let it cool, and take the stones out of the crucible, and you will find them look black; polish them with ashes of tin; they will not only have contracted a tolerable hardness, but have also a fine lustre, much resembling natural diamonds.

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† This is no other than crocus martis. *Ed.*

Plain Directions for polishing these Counterfeits, and also natural Gems.

It is to be observed that all glass, or artificial stones, may be cut and polished after one method, namely, by strewing fine powdered emery upon a leaden plate with water, and, holding the stone firm, grinding it in what form or shape you please.

If you fling ground tripoli, mixed with water, upon a pewter plate, and add a little copper ashes amongst it, it will have the same effect.

Pulverized antimony strewed upon a smooth plate of lead, with tripoli and vinegar, polishes not only glass, crystal, garnets, agates, and amethysts, but all other natural stones, except the diamond. The diamond is only cut with the diamond powder itself. Any such diamonds as can be touched by emery, lead, copper, or other metals, are false; and this is a good test for knowing a real diamond.

All other precious and hard stones may be ground, or cut, with metal and emery; but the polishing is different.

The sapphire is, next to the diamond, the hardest; it may be polished best with antimony and vinegar, or lead, or with calcined flint-stone and water, upon copper.

The ruby is polished like the sapphire.

The emerald and turquoise are polished with potter's clay and water, on pear-tree wood; or with tripoli, upon wood; or with emery, upon pewter.

The beryl is polished with calcined mother-of-pearl, or calcined muscle-shells, upon a board covered with white leather.

A balass is polished with antimony upon copper.

The cornelian, onyx, agate, and jasper, upon tin; or with tripoli, or calcined flint, upon pear-tree wood; or with antimony upon lead.

The amethyst, topaz, turquoise, and other soft stones, are polished upon a board of lime-tree wood, upon a plate of tin, and upon a board with leather. First polish it, top and bottom, upon the wood: the small diamond cuts are done upon the plate of tin, and receive the last polishing upon the board that is covered with leather, with the following powder:

A Powder for polishing soft Stones.

Take iron scales, and mix them with vinegar and salt, and let them stand thus infused for three or four days, the longer the better; then grind the mixture very fine; dry it, and put it in an earthen pot well luted; give it a good fire, and it will be fit for use*.

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* This is simply a crocus, and therefore ordinary crocus martis is equally as good. *Ed.*

PART

PART IV.

ART OF MAKING GLASS;

WITH

THE ART OF PAINTING, AND MAKING IMPRESSIONS UPON GLASS, AND OF LAYING THEREON GOLD OR SILVER; TOGETHER WITH THE METHOD OF PREPARING THE COLOURS FOR POTTERS-WORK, OR DELFT-WARE.

Of Glass.

GLASS is a transparent, brittle, factitious body, produced from sand, flints, alkaline salts, lead, slags. &c. by the melting heat of a very strong fire. At what period the art of glass-making was first invented is altogether uncertain. Some suppose it to have been invented before the flood, but of this they can give no proof; though they rightly conjecture, that the vitrification of the bricks of fire places and furnaces gave the first hint towards glass-making, which in all probability happened as soon as fire was discovered. To those who are curious in forming opinions on this subject, we recommend them to Neri's Art of Glass, with Dr. Merret's notes and improvements;

and we shall now proceed to a branch of much more real utility.

Glass is so extremely elastic, that if the force with which glass balls strike each other be reckoned 16, that with which they recede, by virtue of their elasticity will be nearly 15. When it is suddenly cooled; it becomes highly brittle, which is oftentimes attended with surprising phenomena. Hollow balls made of annealed glass, with a small hole in them, will fly to pieces by the heat of the hand only, if the hole by which the internal and external air communicate be stopped with the finger. Lately, however, such balls have been found out to resist very smart strokes of a hammer, although they are easily shivered in pieces by the fall of very minute and light bodies falling into their cavities. These glasses may be made of any shape; all that is to be observed is, that their bottoms be made thicker than their sides. These experiments were made before the Royal Society, by whose members various reasons have been assigned. Glass appears more fit for the condensation of vapours than metallic substances are. An open glass filled with water, in the summer time, will gather drops of water on the outside, just as far as the water in the inside reaches; and a person's breath blown on it, manifestly moistens it. Glass also becomes moist with dew, which metals do not. A drinking glass filled with water, and rubbed on the brim with a wet finger, yields musical notes, higher or lower as the glass is more or less full; and will make the liquor frisk and leap. Glass is moreover possessed of great electrical virtues.

Materials of Glass.

It has been stated that glass is made of sand, flints, &c. &c.; but there are various saline matters which ought to be particularly mentioned. *Polverine* or *rochetta* is procured from the Levant, and is prepared from a plant called *kali*, which is cut down in the summer, dried in the sun, and burnt in heaps, either on the open ground, or on iron grates; the ashes falling into a pit, grow into a hard mass fit for use when it has been purified. *Kelp*, which grows on our sea coasts, and the ashes of the *fucus vesiculosus*, furnish a similar salt. Pearl-ash, and pot-ash, both of which are procured from vegetable matters, are purified, and employed in glass-making: so also is nitre and borax, and, occasionally, the purified *barilla* of Spain, called *soda*. Other fluxes are used, such as calcined lead, arsenic, smith's clinkers, &c. In general it may be observed, that the more metallic preparations enter the composition of glass, so much the more dense, ponderous, fusible, soft, and coloured it will be. Besides the above materials, the artists employ a stone called *tarso*, which is in fact the body of the glass, and similar to sand, except that being of larger dimensions it may be picked and selected, so as to preserve a clearer and more transparent crystal. At Venice they use a sort of pebble, found in the river Tesino, resembling white marble, called *cuogolo*; and indeed many of our own clear streams in Britain would furnish as good materials as any parts of the world, if we were at the pains of searching for them. Lynn, in Norfolk, and Maidstone, in Kent, produce the white sand for crystal glass; and Woolwich affords the coarser sand for green glass.

To prepare Ashes for making Glass.

TAKE what quantity, and what sort of wood-ashes you will, except those of oak; have a tub ready with a spigot and faucet towards the bottom, and in this tub put a layer of straw, and fling your ashes on it; then pour water upon them, and let the ashes soak thoroughly until the water stands above them: let it thus continue over night; then draw out the faucet and receive the lye in another tub, put under the first for this purpose: if the lye looks troubled, pour it again on the ashes, and let it settle until in runs clear and is of an amber colour. This clarified lye put by, and pour fresh water on the ashes; let this also stand over night, then draw it off, and you will have a weak lye, which, instead of water, pour upon fresh ashes: the remaining ashes are of use in the manuring of land.

After you have made a sufficient quantity of lye, pour it into an iron cauldron, bricked up like a brewing, or washing, copper; but let it not be filled above three parts full. On the top of the brick-work place a little barrel with lye; towards the bottom of which bore a hole, and put a small faucet in, to let the lye run gently into the cauldron, in a stream about the roundness of a straw; but this you must manage according to the quantity of lye, for you ought to mind how much the lye evaporates, and make the lye in the barrel run proportionally to supply that diminution. Care must be taken that the lye do not run over in the first boiling; but if you find it will, put some cold lye to it, and slacken the fire, and let all the lye boil gently to a dry salt: when this salt is cold, break it, and put it into the calcar (see the next article) and raise your fire by degrees, until the salt is red hot, yet so as not to melt it. If you think it calcined enough, take out a piece and let it cool; then break it in two, and if it is thoroughly white, it is done enough; but if there remains a blackness in the middle it must be put in the calcar again, until it comes out thoroughly white. If you will have it still finer, you must dissolve it again, filtrate it, boil it, and calcine it as before: the oftner this is repeated the more will the salt be cleared from the earthy particles, and it may be made as clear as crystal, and as white as snow. Of this may be made the finest glass possible.

According to M. Merret, the best ashes in England are burnt from thistles, and hop-stalks, after the hops are gathered; and among trees, the mulberry is reckoned to afford the best salt.

The most thorny and prickly plants are observed to yield better, and more salt than others; also all herbs that are bitter, as hops, wormwood, &c. Tobacco stalks, when burnt, produce likewise plenty of salt: and it is observed that fern ashes yield more salt than any other ashes.

Description of a Calcar.

In glass-making, the name of *calcar* is given to a small oven or reverberatory furnace in which the first calcination of sand and salt of pot-ash is made, for the purpose of turning them into *frit*. This furnace is fashioned much after the manner of an ordinary baker's oven, ten feet long, seven feet broad in the widest part, and two feet deep. On one side of it is a trench six inches square, the upper part of which is level with the calcar, and separated only from it at the mouth by bricks nine inches wide. Into this trench they put sea-coal, the flame of which is carried into every part of the furnace, and it is reverberated from the roof upon the frit, or other materials put within it, over the surface of which the smoke flies very black, and goes out at the mouth of the calcar: the coals are placed on iron bars, laid in the trench; and the ashes fall through.

Another Method of preparing Ashes.

Take pot-ash, stir and boil it in a clean earthen vessel, in plenty of river or rain-water; let it stand over night and settle; the next day pour off the clear liquor; boil this in an iron kettle until it becomes a hard mass; then beat it into pieces, and put it in a calcar to calcine: dissolve it again in clear water; filtrate, and boil it as before;

and the oftener you repeat it, the clearer and finer will be your glass: but if it is for coloured glass, once or twice doing it will be sufficient.

To make the Glass Frit.

TAKE white silver sand; wash it, and separate all the impurities from it, and let it dry, or, rather, calcine it. Of this take sixty pounds, and of prepared ashes thirty pounds; mix them well together; then set them in the melting furnace; the longer it is melting the clearer will the glass be made. If it stands for two days and two nights, it will be fit to work with, or to tinge with what colour you please. Before you work it, add forty pounds of lead and half a pound of manganese to it. *Or,*

Take ashes, prepared as above, sixty pounds; of prepared silver sand one hundred and sixty pounds, arsenic four pounds, white lead two pounds, clear dry nitre ten pounds, borax two pounds; mix all well together, and proceed as has been directed, and you will have a beautiful crystal. *Or,*

Take prepared silver sand twenty pounds, clear and dry nitre thirty pounds, borax six pounds, arsenic eight pounds, mix these well together, and put them into fusion for four days; then add two pounds of manganese, and four pounds of borax. *Or,*

Take prepared silver sand thirty-eight pounds, prepared ashes twenty-five pounds, arsenic one pound, nitre two pounds, antimony and borax four pounds. *Or,*

Of prepared sand take forty pounds, nitre thirteen pounds and a half, tartar six pounds, arsenic and borax about one pound and a half. *Or,*

Prepared silver sand ten pounds, ashes six pounds, tartar three pounds, nitre four pounds, lime six pounds, borax one pound. But of this, more hereafter will be said.

Description.

Description of a Glass-furnace.

THE ordinary working furnace, for the making blowing of glass, is round, three yards diameter and two yards high; or in these progressive proportions, whether it be built larger or smaller. It is divided into three parts, each of which is vaulted. The lower part is properly called the *crown*, and is made in that form. Its use is to keep a brisk fire, which is never put out. The mouth is called the *bocca*. There are several holes in the arch of this crown, through which the flame passes into another vault or partition, and reverberates into the pots filled with the proper ingredients. Round the insides are eight or more pots placed, with pots piled again on them; in short, the number of pots is double that of the boccas or mouths, or of the number of workmen, that each man may have one pot refined to work out of whilst the other is getting ready. Through the working holes the melted glass, called the *metal*, is taken out of the pots, and the pots are put into the furnace through the same: these holes are stopped with moveable covers made of brick luted, to screen the workmen's eyes from the scorching flames. On each side of the bocca, is a smaller hole, or boccarella, out of which coloured glass, or finer metal, is taken from the upper, or piling pots. Above this furnace or oven there is a third oven, called a *leer*, about five or six yards long, where the vessels of glass are annealed or cooled: this part consists of a tower, besides the leer, into which the flame ascends from the furnace. The tower has two mouths, through which the glasses are put in with a fork, and set on the floor or bottom; but they are drawn out on iron pans, called *fraches*, through the leer, to cool gradually, so that they are cold by the time they reach the mouth of the leer which enters the room where the glasses are to be stowed, called the *sarosel*.

A green-glass furnace is square; and at each angle it has an arch for annealing or cooling glasses, or bottles. The metal is wrought on two opposite sides, and on the other two they have their colours, into which are made linnet holes for the fire to come from the furnace to bake the frit, and to discharge the smoke. Fires are made in the arches to anneal the work, so that the whole process is done in one furnace.

These furnaces must not be of brick, but of hard sandy stones. In France, they build the outside of brick; and the inner part, to bear the fire, is made of a sort of fuller's earth, or tobacco-pipe clay, of which they also make their melting-pots. In Britain the pots are usually made of Stourbridge clay.

It is observed, that the roughest work in this art is the changing the pots when they are worn out or cracked. In this case, the great working hole must be uncovered; the faulty pot must be taken out with iron hooks and forks, and a new one must be speedily put in its place, through the flames (for glass-furnaces are always kept burning) by the hands only. In doing this, the man guards himself with a garment made of skins, in the shape of a pantaloon, that covers him all but his eyes, and is thoroughly wetted all over: his eyes are defended by proper shaped glasses, of a green colour. See plate 5.

A smaller Furnace, for Glass, and other Experiments.

YOUR furnace must be built according to the situation and dimension of your room, about a yard square: at the bottom leave a hole, A, fig. 1. plate 6. which is the receiver of the ashes, and also the drawer of the wind to the fire, which you may make as fierce as you will, by exposing it more or less to the open air. B, is an iron grate, which is about a quarter and a half above the hole A.

C, are holes over the grate, wherein you put the fuel, over the grate is a bricked vault, wherein the flames draw through the hole D, in the upper vault E.

F, are two or more holes, through which you put the crucibles in; you may make one on each side, and make cakes of such clay as the glass makers use, to set them before the holes, and by this means mitigate the flames, which sometimes may strike too fierce upon the upper vault, and give them a little vent.

G, is a hole in the upper vault, which may be covered and uncovered as much as you will, and the flame may either go strait through the funnel H, which at the top is provided with the cover I, and which, on such occasions, must be taken off; or else, in putting on the cover I, you may convey a reverberatory fire through the funnel K, into another little reverberatory furnace, which will be very useful for calcining and preparing several materials, as may happen to be used.

The inside of this furnace must be lined smooth, with such potters clay as the glass-makers use, and two or three inches thick. And having finished it according to this direction, you may place a good many crucibles in at a time, making the holes through which you convey your larger crucibles higher, so that the rim of the crucible may come even with the bottom of the hole, and you may easily convey a ladle, spatula, or any thing else through them. This furnace is the most compendious and useful that can be contrived for a novice in the art of glass-making. Fig. 2, plate 6, is the appearance of the outside.

Instruments for making of Glass.

The absolutely necessary instruments in the art of glass-making may be reduced to the following: a blow-pipe, made of iron, about two feet and a half long, with a wooden handle. An iron rod to take up the glass. Scissars to cut the glass; and shears for the larger-shaped glass vessels. An iron ladle, with the end of the handle cased with wood, to take the metal out of the refining pot and put it into the workmen's pots. A smaller iron ladle, cased in the same manner, to skim the salt which swims at top. Shovels; one like a peel, to take up the glasses; another like a fire-shovel, to feed the fire with coals. A hooked iron fork, to stir the matter in the pots. An iron rake, for the same purpose, and to stir the frit. An iron fork, to change or pull the pots out of the furnace, &c.

Of the Sorts of Glass.

THERE are three principal kinds of glasses, distinguished by the form or manner of working them, viz. 1. *Round glass*, such as phials, drinking-glasses, &c. 2. *Window*, or *Table glass*, of which there are divers kinds, such as crown-glass, jealous-glass, &c. 3. *Plate-glass* for mirrors, &c.

Compositions for White and Crystal Glass.

To make *crystal-glass*, take of the whitest tarso, pounded small, and sifted as fine as flour, two hundred pounds; of the salt of polverine one hundred and thirty pounds, mix them together, and put them into the furnace called the calcar, first heating it. For an hour keep a moderate fire, and keep stirring the materials with a proper rake, that they may incorporate and calcine together; increasing the fire for five hours; after which the matter is taken out, being sufficiently calcined, and is called *frit*. After this, remove it immediately from the calcar to a dry place, and cover it up from dust, for three or four months. Now, to make the crystal glass, take of the above crystal frit, called also *bollito*, and set it in the melting pots in the furnace, adding to it a due quantity of manganese; when the two are fused, cast the flour into fair water, to clear it of the salt called *sandiver*, which would otherwise make the crystal obscure and cloudy. This washing must be repeated again and again, till the crystal be fully purged; or this scum may be taken off by proper ladles. Now set it to boil for four, five, or six days; which being finished, see whether it have manganese enough; and if it be yet greenish, add more manganese, at discretion, by little and little at a time, taking care not to over dose it, because it will incline it to a blackish hue. Let it clarify, and become of a shining hue; which done, it is fit to be used, and blown into vessels of any kind.

Compositions for Flint Glass.

FLINT GLASS, as it is usually called by us, is of the same general kind with that which in other places is called crystal glass. It has this name from its having been originally made with calcined flints, before the use of white sand was understood; and it has retained this name, though there are now no flints used in its composition. This glass differs from the crystal glass, in having lead in its compositon, to flux it, and white sand for its body, whereas the fluxes used in the other are salts, or arsenic, and the body consists of tarso, white river pebbles, and such stones. To the lead and white sand a due proportion of nitre is added, and a small quantity of magnesia. The most perfect kind of flint glass is made by fusing, in a very strong fire, one hundred and twenty pounds of white sand, fifty pounds of red-lead, forty pounds of the purest pearl-ash, twenty pounds of nitre, and five ounces of magnesia. Another composition of flint glass is said to be the following: one hundred and twenty pounds of white sand, fifty-four pounds of the purest pearl-ash, thirty-six pounds of red-lead, twelve pounds of nitre, and six ounces of magnesia. To either of the above compositions, a pound or two of arsenic may be added, to increase the flux of the composition. A still cheaper flint glass may be made with one hundred and twenty pounds of white sand, thirty-five pounds of the best pearl-ash, forty pounds of red-lead, thirteen pounds of nitre, six pounds of arsenic, and four ounces of magnesia; or, instead of the arsenic may be substituted fifteen pounds of common salt; but this will make it more brittle than the other. But the cheapest of all the compositions hitherto employed, consists of one hundred and twenty pounds of white sand, thirty pounds of red-lead, twenty pounds of the best pearl-ash, ten pounds of nitre, fifteen pounds of common salt, and six pounds of arsenic.

A harder Glass than the foregoing.

Take four ounces of borax, and an ounce of fine washed white sand; reduce both to a subtil powder, and melt them together in a large close crucible, set in a wind furnace, keeping up a strong fire for half an hour; then take out the crucible, and let it grow cold, and then break it, and there will be found at the bottom a pure hard glass, capable of cutting common glass like a diamond. It is observed, that time makes a sensible impression on glasses in which borax makes too great an ingredient.

To calcine Brass, which in Glass makes a Sky or Sea-green.

BRASS is copper mixed and fused with *Lapis Calaminaris*, which not only changes it into a gold colour, but increases its weight; this mixture gives a sea-green or sky-colour to glass, when it is well calcined; and to do this, observe the following rules:

Take brass plates, and cut them into small slips, and put them into a crucible; cover and lute it well, and give it a reverberatory fire in a furnace, yet not a melting one, for if it melts, all your labour will be lost: let it stand in that heat for four days, by which time it will be well calcined; then beat it to an impalpable powder and sift it; grind it fine on a porphyry, and you will have a black powder; spread it on tiles, and keep it on burning coals, or the round hole of a furnace, for four days; clear it of the ashes that have fallen upon it, pulverize and sift it, and keep it for use. To try whether it is calcined enough, fling a little into melted glass, and if it swells, the calcination is enough, but if not, then it is either not calcined enough, or else it is burned, and will not colour the glass near so well as when the calcination is perfect.

To calcine Brass after another Manner, for a transparent Red Colour, or a Yellow.

CUT your brass into small shreds, and lay it *stratum super stratum* in a crucible, with powdered sulphur; set it on a charcoal fire in a furnace for 24 hours, then powder and sift it; when this is done, put it covered into the furnace hole, for 10 hours, to reverberate, and when cold, grind it again very fine, and keep it for use.

General Observations for all Colours.

1. ALL the melting-pots must be glazed with white glass on the inside; for a new earthen pot that is unglazed will cause the colours to look bad and foul; but the second time of using these pots they lose their foulness.

2. Observe that these pots serve for one colour only, and may not be used for another: every colour must have its own pot, except they correspond together.

3. Let the powders be well calcined; neither too much nor too little.

4. Your mixtures must be made in due proportion, and the furnace must be heated with hard and dry wood.

5. You must use your colours divided: one part you must put in the frit before it is melted, and the other after it is melted and become fine and clear.

To make Glass of Lead, which is the fittest for receiving of most Colours.

TAKE of calcined lead 15 pounds; of rochetta, or pulverized crystal frit 12 pounds; mix them well, and put them together into a melting pot, then into a furnace, and, at the end of ten hours, cast them into water: clear the melting pot of the lead that remains, and return the metal into it, which, after 10 hours heat, will be fit to work with.

How to work the said Glass.

BEFORE you take it upon the iron, raise the glass first in the pot a little, then take it out to let it cool for a small space of time, after which work it on a clean and smooth iron plate.

Blue Glass.

TAKE four ounces of calcined and pulverized rock crystal, two ounces of nitre, one ounce of borax, half a pound of manganese, one pound of indigo-blue.

A Chrysolite Glass.

To one pound of frit; take pulverized verdigrise three ounces and a half, red lead one ounce.

A Sapphire Green Glass.

To one pound of the above composition, or crystal frit, take one ounce of good zaffre, and of very fine pin-dust two pounds.

To make fine Green Glass of Tin.

TAKE the filings, or shavings of tin, nine parts; dissolve them in aqua-fortis; sweeten the calx with clean spring water; then take 18 parts of nine-times calcined antimony: its calcination must be repeated until it has done evaporating. Both these melted together, make a fine crysolite or emerald.

This glass will melt upon silver, like enamel, and may be used, on several occasions, for such things as are proper for ornaments.

To make a Ruby-coloured Glass.

TAKE good aqua-regia four ounces; fling into it, by little and little, thin bits, or filings of tin, one ounce, and let it dissolve: take the finest gold, as much as you will, and dissolve it in aqua-regia: take a clean glass with clear spring-water, and pour the solution of the gold, as much as you please, into it; the same quantity put also to it of the solution of the tin, and the water will turn to a fine rose colour; with this water moisten several times your glass frit, and let it dry*; then proceed as you do with other glass in fire; at first it comes out white, but afterwards becomes a fine ruby.

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* Instead of letting it dry, let the purple colour subside, and then pour off the liquor, and use the dry powder only.—This powder is of various tints of purple, and is the more valuable in proportion to the intensity. *Ed.*

THE ART OF GLASS IN MINIATURE.

The Art is performed by the Flame of a Lamp, in the following Manner:

FIRST, provide yourself from the glass-house with several pipes of glass, that are hollow in the inside, of several colours, and different sizes: then you must have a table, as you see represented at fig. 3, plate 6. A is the artist, who is furnished with a lamp and oil, or with tallow, and a large wick of twisted cotton; below the table is a pair of bellows. B. When the artist treads the treadle fastened to the bellows, the wind will be conveyed through the pipes under the table to the small opening by C C, directly in which are placed the lighted wicks of the lamps. The smoke which issues forth from the lamp, is conveyed through a broad funnel made of tin or wood, E.

The wind, which strikes in a sharp point against the flame, occasions such a violent heat, that it will dissolve the most stubborn glass, and you may, after you have softened the end of your pipe in the flame, blow through the hollow, and form, with small plyers and other useful tools, whatever you please: small twisted nooses of wire are very convenient to hold your work in, in order to shape and join different colours to one piece. The whole art depends chiefly upon practice.

The usefulness of such a table answers several other purposes; as, for trying of metal-ore: in this case put some of it in a hallowed charcoal, &c. and by directing the wind through the lamp upon the ore, the heat will melt it immediately, and shew what it contains. In soldering, it is also very convenient; not to mention the conveniency which such a table affords to practitioners in chemistry.

How

How to lay Silver on Glass Utensils, Plates, Dishes, Salts, Drinking Cups, &c.

TAKE of pure silver what quantity you please, and beat it very thin; then put it into a matrass, and pour twice its weight of aqua-fortis upon it, and you will presently perceive the silver dissolve: when you observe its ceasing to work, put your matrass on warm sand or ashes, and it will begin to work afresh; let it thus stand till all your silver is dissolved. After this pour the solution out of that matrass into another, and evaporate a little, and let the matrass remain on the sand till it is cool; then take it off, and let it stand for twenty-four hours, and the silver will shoot into white crystals; from these pour off the solution which remains, and evaporate again the half of the liquor; then set it, as before, to crystallize; this repeat, till all the silver is turned into crystals: take them out of the glass, lay them upon whited-brown paper to dry, and preserve them for use.

Of these crystals take as much as you will, and put them into a matrass, and pour upon them two or three times their weight of the strongest spirit of sal ammoniac; lute it well, and put it into a gentle warmth for eight or ten days to digest, and it will contract a blue colour; pour it off, filter it, and evaporate in a sand-bath a little, and there will remain a glass-green liquid; with this melt your glass, and put it into a glass furnace, or into any gentle heat, your glass will look as if it were silver plate.

But in case there should be an oversight, and the spirit of sal-ammoniac be too much drawn off, and the silver turned to a green salt, then pour as much of that spirit upon the silver again as will bring it to a green liquid.

A curious Drinking Glass.

TAKE two smooth drinking glasses, fitted close to each other, so that the brims of both may be even; then paint on the inside of the larger glass with oil colours, what you will, either in imitation of mosaic, or any other invention; and when dry, you may with the point of a needle open fine veins or other embellishments, &c. Then oil it all over with old linseed oil; and before it is quite dry, whilst clammy, lay leaf gold upon it; press it close down to the glass with cotton, and let it dry thoroughly. The mean while, take the other lesser glass, and lay a thin clear varnish on the outside, and when almost dry, lay on leaf gold, and the inside of the glass will look all over gilded. When this is dry, put it into the larger glass, and make a paste of chalk and lack varnish, with this lute the rims of the two glasses, so that it may not be perceived, but look as if it were made out of one piece; let it thoroughly dry, and give it another layer of lac varnish, with a fine pencil, and let it dry; then smooth it with pumice stone, and lay on it a thin varnish; and when that is almost dry, gild it with leaf gold, and give it two or three layers of lac varnish, and the gold will remain firm.

Instead of painting with oil colour, if you only anoint the inside of the glass with linseed oil, and then strew it over with spangles, and put the inside glass gilded, to join, it will have a singular beauty. This hint will animate the ingenious to try farther experiments of this amusing kind.

How to Quicksilver the inside of Glass Globes, so as to make them look like Looking-glass.

TAKE two ounces of quicksilver, one ounce of bismuth, of lead and tin half an ounce each.

First put the lead and tin into fusion, then put in the bismuth; and when you perceive that in fusion too, let it stand till it is almost cold, and pour the quicksilver into it.

After this, take the glass globe, which must be very clean, and the inside free from dust; make a paper funnel, and put it in the hole of the globe, as near to the glass as you can, so that the amalgam when you pour it in, may not splash and cause the glass to be full of spots; pour it gently, and move it about, so that the amalgam may touch every where. If you find the amalgam begin to be curdly, and to be fixed, hold it over a gentle heat, and it will flow easily again. If you find the amalgam too thin, add a little more lead, tin, and bismuth to it. The finer and clearer your globe is, the better will be the looking-glass.

THE ART OF PAINTING UPON GLASS.

This noble art being the admiration of all who have any tolerable taste of designing or painting, it will not be improper to give the ingenious enquirer after this mystery some few hints, not only to satisfy his curiosity with its nature, but also, if he be inclined, to lead him into the practice of it; which we shall do in the plainest and shortest manner possible.

First then, chuse such panes of glass as are clear, even, and smooth.

2. Strike one side of each pane with a clean spunge, or a soft hair pencil, dipt in gum-water, all over.

3. When it is dry, lay the clean side of the glass on the outlined design you intend to copy, and with a small pointed pencil (furnished with black colour, and prepared for that purpose, as shall be directed) delineate the outlines, or capital strokes; and where the shades appear soft, work them by dotting, and easy strokes, one into another.

4. After you have finished your outlines and shades in the best manner you are able, take a larger pencil, and lay on your colours in their respective places; as a carnation in the face, hands, &c. green, blue, red, or any other colour on the drapery, &c.

5. When you have done this, heighten the lights of your work carefully with an unsplit stiff pen, with which take off the colour, by way of etching, in such places where the light is to fall strongest, and where it is of use to give the beard, or hair, a graceful turn.

6. You may lay all sorts of colours on the same side of the glass you draw your design upon, except yellow; which lay on the other side, in order to prevent its flowing and mixing with other colours, and spoiling your work.

Necessary Observations in the baking of Glass, or burning in the Colours, after it is painted.

YOUR furnace for baking painted glass must be built square, with three divisions. The lower division is for receiving the ashes, and for a draught for the fire.

The middle division is for the fire, which has an iron grate below, and three iron bars cross the top, to set the square earthen pan upon, which contains the painted glass.

The third division has the aforementioned bars at the bottom, and a lid at top, in which are five holes for the smoke and flame.

The earthen pan is made of good potters clay, according to the shape and dimensions of the furnace, about five or fix inches high, with a flat bottom. It must be fire proof, and no larger than to have at least two inches' space all round, free from the sides of the furnace*.

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* Such is the extreme simplicity of the art, and the high value it bears, that it is wonderful so few artists have turned their talents towards it!

When you are going to bake your glass, take quicklime, which previously has been well nealed, or made red hot in a fierce coal fire: when cold, powder it, and sift it through a small sieve, as even as you can, all over the bottom of the pan, about half an inch thick; then with a smooth feather wipe it even and level; when this is done, lay as many of your painted glasses as there is room. This continue till the pan is full, sifting upon every layer of glass a layer of the mixed powder, very even, about the thickness of a crown piece. Upon the uppermost layer of painted glass, let the layer of powder be as thick as the bottom. Put the pan, thus filled to the brim, upon the iron bars in the middle of the furnace, and cover the furnace with a cover made of potter's earth; lute it very close all round, to prevent any vent but what comes through the holes of the cover. After you have ordered the furnace in this manner, and the luting is dry, make a slow charcoal, or dry wood, fire, at the entrance of the furnace, increase it by degrees, lest by a too quick fire the glass should be subject to crack; continue thus to augment your fuel, till the furnace is full of charcoal, and the flame conveys itself through every hole of the cover: keep thus a very violent fire for three or four hours, and then you may draw out your essays, which are pieces of glass on which you have painted some yellow colour, and placed against the pan; and when you see the glass bended, and the colour melted, and of a qualified yellow, you may conclude that your work is near done; you may also perceive by the increase of the sparklings of the iron bars, or the light streaks on the pan, how your work goes on. When you see your colours almost done, increase the fire with some dry wood, and put it so that the flame may reverberate all round the pan: then leave the fire, and let it go out, and the work cool of itself. Take it out, when quite cold, and with a brush clear your glass gently from the powder that may lie upon it, and your work is done.

The colours in use for painting upon glass, are next to be treated of, and are as follows:

For a Carnation Colour.

TAKE menning* one ounce, red enamel two ounces; grind them fine and clean with good brandy, upon a hard stone: this, if slightly baked, will produce a good carnation. *Or,*

Take red chalk eight ounces; iron scales and litharge, each two ounces; gum arabic half an ounce; grind all together for half an hour, quite stiff; then put it in a glass, and let it settle for 14 days.

Of Black Colours.

TAKE scales of iron from the anvil, fourteen ounces and a half; mix with it two ounces of white glass, one ounce of antimony, manganese half an ounce; grind them with good vinegar to an impalpable powder. *Or,*

Take scales of iron one part, and rochetta one part, grind them together very fine upon an iron plate, for one or two days; when they begin to be tough, and look yellowish, and clog to the muller, it is a sign that it is fine enough. *Or,*

Take one pound of enamel, three quarters of a pound of copper flakes, and two ounces of antimony, grind them as before directed. *Or,*

Take glass of lead three parts, copper flakes two parts, and one part of antimony, proceed therewith as before.

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* Unknown. *Ed.*

A Brown

A Brown Colour.

TAKE one ounce of white glass, or enamel; half an ounce of good manganese; grind them first with vinegar very fine, and then with brandy.

A Red Colour.

ONE ounce of red chalk, ground, and mixed with two ounces of ground white enamel and some copper flakes, will make a good red; you may try, with a little, whether it will stand the fire, if not, add some more copper flakes to it. *Or,*

Take red chalk, that is hard and unfit to draw with, one part; of white enamel one part; and one-fourth part of orpiment; grind them well together with vinegar; and when you use them, avoid the smoke, which is poisonous. *Or,*

Crocus martis, glass of antimony, and yellow lead glass, such as the potters use, of each an equal quantity: a small matter of silver calcined with sulphur: grind them together very fine, and they will be fit to paint with, and produce a good red. *Or,*

Take one half part of iron flakes, one half part of copper ashes, one half part of bismuth, a little silver filings, three or four beads of red coral, six whole parts of red frit from a glass house, one half of litharge, one half of gum, and thirteen whole parts of red chalk.

A Blue Colour.

TAKE *Burgundy* blue, or blue verditer, and lead glass, an equal quantity; grind them with water to a very fine powder, and when you use them, lay the flowers that are to be of a blue colour, all over therewith; then raise the yellow parts opened, with a pen, and cover them with a yellow glass colour: observe, that blue upon yellow, and yellow upon blue, always make a green.

Another Blue Colour.

Blue verditer or smalt, mixed with enamel, will make a good blue paint.

A Green Colour.

Green rocaille, or small beads of the same colour, two parts, brass file dust one part, menning two parts; grind them together clear and fine, and you will have a good green when it comes out of the pan. *Or,*

Æs Ustum two ounces; menning two ounces; fine white sand eight ounces: grind them to a very fine powder, and put them into a crucible; then lute the lid, and give it for one hour a good quick fire in a small furnace. After this, draw it off to cool; when cold, pound it in a brass mortar, adding the fourth part in weight to the powder; grind and mix it well together, and put it into a crucible; then cover and lute it well, and give it a good heat for two hours in a furnace.

A fine Yellow Paint for Glass.

It has been found by experience, that the best yellow for painting upon glass, is prepared of silver; wherefore, if you would have a fine and good yellow, take fine silver, beat it into thin plates, and dissolve and precipitate it in aqua-fortis, as has been directed; when it has settled, pour off the aqua-fortis, and grind the silver with three times the quantity of well burned clay from an oven, very fine; and with a soft hair pencil lay it on the smooth side of the glass, and you will have a fine yellow. *Or*,

Melt as much silver as you please in a crucible, and when in fusion, fling, by little and little, so much sulphur upon it, until it is calcined; then grind it very fine on a stone; mix it with as much antimony as is the weight of the silver; and when these are well ground together, take yellow ochre, neal it well, and it will turn to a brown-red, which quench in urine, and take thereof double the quantity above specified; mix it all together, and after you have ground it very fine, lay it on the smooth side of the glass. *Or*,

Neal some thin plates of silver; then cut them into small bits; put them with sulphur and antimony into a crucible; when they are dissolved, pour them into clear water, and thus mixed together, grind them very fine.

A pale Yellow.

STRATIFY thin plates of brass in an earthen pipkin with powdered sulphur and antimony, and burn them until it yields no more flame; then pour them red hot into cold water; take out this and grind it fine. Of this powder one part; of yellow ochre, after it is nealed and quenched in vinegar, five or six parts; let it dry; then grind it on a stone, and it will be fit for use.

How to deaden the Glass, and fit it to paint upon.

TAKE two parts of iron flakes; one part of copper flakes, three parts of white enamel; grind them all together, with clear water, on a marble stone, or upon a brass or iron plate, for two or three days, as fine as possible; with this rub your glass well over, especially that side you draw your design upon, and you will finish your work much neater.

Some general Observations on the Management of painting and baking of Glass.

FIRST when you lay your glass in the pan, let the painted side be placed undermost, and the yellow uppermost.

2. Dilute all your colours with gum-water.

3. Grind the black and red upon a copper-plate; other colours you may grind on a piece of glass, or a stone.

4. Glass-colours ready prepared are, glass enamel, which is brought from *Venice* in cakes of several sorts; also the small glass beads that are brought over from *Germany*, especially from *Franckfort* on the *Main*. Old broken pieces of painted glass are good for that purpose; so is the green glass of potters, and the glass drops that run from the ware in the furnace.

5. The colours which are used by potters, for painting on earthen ware, may also be used for painting on glass.

A particular Way to paint upon a Drinking Glass.

TAKE a small quantity of linseed; bruise it, and put it for four or five days in a little canvas bag, in rain-water, and change the water every day; then press out the moisture, and you will have a clammy substance, like glue; with this grind your colours as usual; then paint, or mark with a pencil, what you please upon the glass, and give it by degrees a thorough heat; with the same glue you may also gild the glass, before you put it into the fire.

A fine Gilding for Glass.

TAKE gum-ammoniacum; dissolve it over night in good white-wine vinegar, and grind the gum-ammoniacum, and a little a little powdered gum-arabic well together with clear water; when they are well incorporated and fine, then write or draw upon your glass what you please; and when almost dry, so that it is but a little clammy, lay on your gold, press it down with some cotton, and let it stand over night; rub the loose gold afterwards, with a little cotton, gently off the glass, and you will see the ornaments, figures, or writing, to the perfection you designed; then dry it slowly over a gentle heat, increasing it by degrees, so as to make it red hot, let it cool of itself, and the gold will look fine, and stand wind or water.

To write or draw upon Glass.

Take two parts of lead, one part of emery, and a little quantity of white lead, grind them very fine with clear water; then temper them with gum-water, and with a soft hair pencil lay all over the outside of your glass, and when dry, you may, with a pen, draw or write upon it what you please; then increase the fire from a gentle warmth, to make the glass red hot; let it cool, and you will see your drawing, or writing, fair upon the glass, which will not be defaced either by cold or hot water.

THE

ART OF GLAZING AND PAINTING ON FINE EARTHEN-WARE, COMMONLY CALLED DELFT WARE.

Potters who paint with colours on earthen ware, may be ranged in the same class with painters upon glass, since they use almost the same materials, and, in many respects, the same method.

What has already been said under the foregoing head, is sufficient; and may serve novices in designing and painting, as an instruction to paint flowers, landscapes, figures, or whatever else, upon earthen ware. We shall, however, set down some receipts that chiefly relate to the glazing of earthen ware: but first we shall shew,

How to prepare the Clay for Delft *Ware.*

Take one part of calcined flint, one part of chalk, and one part of capital, or the cream of clay; mix and work them well to a proper consistence.

To prepare a White Glazing.

Take of lead two pounds, and of tin one pound; calcine them to ashes, as has been directed before. Of this take two parts; calcined flint or pebble, one part; salt, one part; mix them well together, and melt them into a cake.

The Rotterdam *fine shining White.*

Take of clean tin ashes two pounds, lead ashes ten pounds, fine *Venice* glass two pounds, tartar half a pound; melt them into a cake. *Or*,

Lead ashes eight pounds; tin ashes three pounds; fine clear calcined flint, or pebble, six pounds; salt four pounds: melt them into a cake. *Or*,

Calcine eight pounds of lead, and four pounds of tin, into ashes; of these take one quart, salt and pebble of each one pound; melt them into a cake.

Another fine White for Earthen Ware.

CALCINE six pounds of lead, and three pounds of tin, to ashes; whereof take two parts, salt three parts, pebble or flint three parts; melt them into a cake.

Another White.

TAKE eight pounds of lead, and four pounds of tin ashes; among which mix six pounds of *Venice* glass, and a handful of rock-salt: melt them into a cake.

Saltzburg *White.*

TAKE three parts of lead, and six parts of tin; or six parts lead, and three parts tin; salt three parts; tartar one part; and pebble five parts, &c. *Or,*

Take five pounds of lead, one pound of tin, three pounds of flint, three pounds of salt, &c. *Or,*

Take six pounds of lead, and one pound of tin; melt and burn them to ashes; whereof take twelve spoonfuls, twelve of flint, and twelve of fine wood ashes.

To lay a Ground upon Earthen Ware, on which the White Glass will spread the better.

TAKE calcined tartar one pint, and flint and salt, of each one pint; mix them together, and use them for a layer, or ground, over your earthen ware, before you glaze them.

The right Dutch *Mastirat for White Porcelain.*

TAKE calcined pebble, flint, or sand, one hundred pounds; of soda forty pounds; wood ashes thirty pounds. This mixture is by the *Dutch* called *mastirat*: of this take one hundred pounds, tin and lead ashes, together, eighty pounds, common salt ten pounds; melt them three times into a cake.

The tin and lead ashes are made of one hundred pounds of lead, and thirty pounds of tin.

The common Ware is thus glazed.

TAKE forty pounds of clear sand, seventy-five pounds of litharge or lead ashes, twenty-six pounds of pot ashes, and ten pounds of salt; melt them three times into a cake, quenching it each time in clear cold water. *Or,*

Take clean sand fifty pounds, lead ashes seventy pounds, wood-ashes thirty pounds, salt twelve pounds: melt them to a cake.

With this mixture they glaze fine and coarse, and set it in an earthen glazing pan, which is round: the ware is set in them, upon three-cornered bars that go through the like holes in the pan, and the ware is kept asunder from touching one another: the pan must be entirely closed up.

COLOURS FOR POTTER's GLAZE-WORK.

A fine Yellow.

TAKE red-lead three pints; antimony and tin, of each two pounds; melt them into a cake; grind it fine, and melt it again. Repeat this several times, and you will have a good yellow. *Or,*

Take fifteen parts of lead ore, three parts of pale litharge, and fifteen parts of sand. *Or,*

Tak

Take eight parts of litharge, nine parts of calcined flint, one part of antimony, and a little iron filings; calcine and melt them to a cake.

A fine Citron Yellow.

TAKE six parts of red lead, seven parts of fine red brick-dust two parts of antimony; melt them to a cake.

A Green Colour.

TAKE eight parts of litharge, eight parts of *Venice* glass, four parts of brass dust; melt them for use. *Or,*

Take ten parts of litharge, twelve parts of flint or pebble, one part of *æs ustum,* or copper ashes.

A Blue Colour.

TAKE lead ashes one pound, clear sand or pebble two pounds, salt two pounds, white calcined tartar one pound; *Venice* or other glass, sixteen pounds; zaffre half a pound; mix them well together, and melt them; quench them in water, and melt them again; repeat this several times: but if you will have it fine and good, it will be proper to put the mixture into a glass furnace, for a day or two. *Or,*

Take litharge four pounds, clear sand two pounds, zaffre one pound; calcine and melt it together. *Or,*

Take twelve pounds of lead, one pound of tin, and one pound of zaffre, five pounds of sand, and three pounds of salt; tartar and glass one pound; calcine, and melt into a cake. *Or,*

Take two pounds of litharge, a quarter of a pound of sand, one pound of zaffre, and one pound of salt; melt them as directed. *Or,* One part of tartar, one part of lead ashes, one part of zaffre, one part of sand, and two parts of salt; melt as before.

A Brown Colour.

TAKE of common glass and manganese, of each one part, lead glass twelve parts.

A Flesh Colour.

TAKE twelve parts of lead-ashes, and one of white glass.

A Purple Brown.

TAKE lead-ashes fifteen parts, clear sand eighteen parts, manganese one part, white glass fifteen measures, and one measure of zaffre.

An Iron Grey.

TAKE fifteen parts of lead-ashes, fourteen parts of white sand, five parts of copper-ashes, one of manganese, one of zaffre, and one of iron filings.

A Black.

TAKE lead-ashes eighteen measures, iron filings three, copper ashes three, zaffre two; this, when melted, will make a brown black; but if you will have it blacker, put some more zaffre to it.

A Brown on White.

Manganese two parts, red lead and white glass one part; melt them well together.

A fine Red.

Take antimony two pounds, litharge three pounds, rust of iron calcined one pound; grind it to a fine powder.

To glaze with Venice Glass.

When your ware is well dried, and ready to bake, strike it all over with white-wine lees; then lay on the Venice glass (ground fine and mixed with salt of tartar and litharge) and bake it as directed.

A Green.

Take copper dust two parts; yellow glass two parts; melt them twice. *Or,*

Two parts of copper filings, one of lead-ashes, and one of white glass; melt them to a cake.

A Yellow.

Menning three parts, brick-dust two parts, lead-ashes two parts, antimony two parts, sand one part, of the above white glass one part, well calcined, and melted. *Or,*

Red lead four ounces, antimony two ounces; melt them to a cake.

A good Yellow.

TAKE of antimony, red lead, and sand, an equal quantity; melt to a cake.

A fine Blue Glass to paint with.

TAKE lead ashes one pound, clear sand two pounds, salt two pounds, white calcined tartar one pound, flint glass half a pound, zaffre half a pound; melt them together, and quench them in water; then melt them again, and repeat this several times.

Zaffre, finely ground by itself, makes a good blue to paint on white-glazed earthen ware.

A Brown.

ONE part of manganese, one of lead, and one of white glass.

A Liver Colour.

TAKE twelve parts of litharge, eight of salt, six of pebble or flint, and one of manganese.

A Sea Green.

TAKE five pounds of lead ashes, one pound of tin-ashes, three pounds of flint, three quarters of a pound of salt, half a pound of tartar, and half a pound of copper dust.

To lay Gold, Silver or Copper on Earthen Ware, so as to resemble either of these Metals.

MAKE any utensil of fine potters earth; form and shape it thin, neat, and silver fashion; then bake it, and when baked, glaze it: but, before you bake it again, if you wish to silver, gild, or copper it, take a regulus of antimony and melt any of the above metals with it, and beat it to a powder; grind it with water, very fine, and glaze it therewith. Then bake it, and when done, the whole utensil will look like silver; for when it comes into the fire, the antimony evaporates and leaves the silver, &c. behind. But if you will silver or gild it only for ornament sake, and keep it from any wet, then you may lay on the gold or silver leaves with brandy, and afterwards polish and finish it in the best manner, after the common method.

PART V.

SEVERAL RECEIPTS FOR CASTING IN *SILVER, COPPER, BRASS, TIN, STEEL,* AND OTHER METALS;

LIKEWISE IN WAX, PLASTER OF PARIS, WOOD, HORN, &c.—WITH THE MANAGEMENT OF THE RESPECTIVE MOULDS.

To prepare Clay for making all Sorts of Moulds to cast Gold, Silver, and other Metals in.

TAKE clay, as much as you will; put it into an earthen pot that is glazed, and cover and lute it very close; then put it into a potter's furnace, and let it stand as long as other earthen ware. After it is burned, and cold, grind the clay upon a colour-stone very fine; sift it through a fine hair sieve into clear water, and after it is settled, pour off the water, and grind the clay once more upon the stone, as fine as possible; then wash it again in fair water as before, and set it in the sun, or in a warm place, to dry.

After this burned and washed clay is thoroughly dry, take of it three pounds, sal-ammoniac two pounds, tartar two pounds, vitriol one pound; mix them together, and put this mixture into one or two pots; pour upon it about seven quarts of clean water, and boil this composition for some time; then take this water, whilst it is warm, and mix your burned clay therewith to such a consistence that you may form it into balls; lay these in a warm place to dry, and when dry, put them into an earthen pot as before, and give them another baking among the earthen ware, and when cold, grind them fine, and that powder will be fit for use.

The clay being thus prepared, take sal-ammoniac, and put it into a glass with water, that holds about two quarts; put so much of the sal-ammoniac to the water as will dissolve it over a gentle warmth, and let it stand one or two hours closed up; then take your powder of clay, and temper it with this water to such a consistence as to form it into balls, and make what moulds you please thereof. When you cast your metal, you must make your mould red hot; and be also very nimble in the pouring out your melted metal.

To make Moulds of Clay to cast Brass or other Metals in.

Take good clear clay, such as the pewterers use; take also cloth shaving, or fine short plucked cotton, and fine clear sand, and if the sand is not fine enough, grind it on a colour-stone; mix this with the clay to such a consistence as is fit to make or form your moulds thereof. Your clay must not be made soft with water, but with strong beer; and when you cast, let your mould be red hot.

If you would have a fine and sharp cast, sift over your clay some fine washed ashes, before you make the impression.

To prepare Moulds, which need not to be heated, for casting Metal in.

TAKE fine sand, such as the goldsmiths use; mix it with lamp-black, as much as you think proper; then temper it with rape, or linseed oil, fit to make your moulds thereof; whatever you cast in them, comes not only out neat and sharp, but you have no occasion to heat your mould, as is required in other cases: you must observe that your sand is very dry before you temper it with the oil.

The Preparation of Mantua Earth, for Moulds.

TAKE one part of Mantua earth, one part of charcoal dust of burnt birch, and one part of salt; mix with them an equal quantity of tartar; boil up the mixture in a copper pan, three several times: with this water, which keeps always good, moisten and temper your earth, so as to form it into balls between your hands; and when you make your mould, roll your earth with a roller, till it is smooth and pliable; then you may form it into what fashion you please. In this mould you may cast before it is dried; and when you have cast, take off the earth which is dried through the heat of the metal; grind the same again, and temper it, as you did at first, to use it again.

A particular Sort of Mould, in which one may cast very fine and sharp.

TAKE horse muscle-shells; or, for want of them, oyster-shells; let them be calcined in a potter's furnace; then pulverize and temper them with urine: of this make your moulds, and you will cast very fine and sharp.

To impress Basso Relievo, or Medals, in Imitation of Ivory.

TAKE of prepared clay one pound, fine plaster of Paris eight ounces, white starch eight ounces; mix these together, and beat up the mixture with the white of six or eight eggs; put to it three ounces of clear gum arabic; stir it well together to a paste, and put so much of the dry mixture to it as will knead it like dough; then press it into a mould with the palm of your hand, and let it dry in the sun, observing to lay the paste side on a smooth board, and it will be clear and hard, like ivory. You may impress all manner of medals and curiosities, and make them of what colour you please.

To impress Medals and other things in Basso Relievo, on Paper.

TAKE the shavings of superfine white paper, and steep them in fair water for six or eight days; then put them into a clean earthen pot, with water, and boil them for two or three hours: this done, take them out of the pot, with as little moisture as possible, and stamp them in a stone mortar very small and fine; then put them into a clean linen bag, and hang that in a vessel with clean water, changing the water once or twice a week: when you have occasion to use it, take as much as you want out of the bag, squeezing the water from it, and put it on the mould, pressing it down gently with a spunge, which will soak up the water, and make the impression more perfect; this being done, set the mould to dry in the sun, or in a warm room, and when dry, the impression will come off as fair and sharp as if cast in plaster of Paris.

To cast Vegetables in Moulds peculiarly prepared for Silver.

TAKE fine and clear clay that is dry, and pound it in a mortar; then take a copper or iron pan; put in your clay, and give it a brisk fire, and after you have heated it thoroughly, take it off and let it cool; then take one part of this clay, and one part of plume alum; grind them together, and cast the mixture in little tents, which put into a fire to neal; beat it very fine; and when you would form your plant, take one part of this powder, and one part of plume alum; grind them together, and add as much of the clay powder as the mixt matter contains, and mix and grind them all together. Then take some potter's clay, to make a coffin round your plant; spread it in what manner you think proper; and after the coffin is dry, anoint the inside thereof, as also the plant with good brandy; dust the before prepared clay, and the plant, gently through a fine cambric; and when you have covered it all over as thick as it will bear, strike the raised coffin a little with your hand or hammer, and the dust will settle closer to the plant, and make the silver come out the sharper.

After the powder is well settled, and your coffin closed, cover it fine with dead charcoal, and then lay some live ones over them; let the fire gradually descend to the coffin, and heat it by degrees to a strong glue; then let it cool of itself with the fire; take, afterwards, fine clay, fine sand, and some wool shearings; mix these together; beat and knead it well into one another; then temper it with glue, and fill your coffin with it all over the plant, leaving an opening at the stalk for the inlet; then put it again into the fire and make it red hot, and with a pair of bellows, first closed, draw out the ashes from the inlet, and it will be ready for casting.

Then take oil of tartar, which is made of pounded salt of tartar, and scrape a little sal-ammoniac into it, to give it the substance of a thin paste, which is a good flux for silver; fling some of this upon your silver, when in fusion, and it will cast fine and sharp.

After it is cast, anoint the silver plant with oil of tartar; lay it on live coals; neal it, and then boil it in tartar, to which add a little salt, and this will give it a fine bright pearl-colour.

Powders for Moulds to cast all Sorts of things in Gold, in Silver, or in other Metals.

TAKE powdered plaster of Paris; or instead, take alabaster in powder, and sift it through cambric, or a very fine hair sieve, and put it into an iron pan, over a clear coal fire; stir it about until it begins to boil and bubble up like water; keep it stirring; recruit your fire, and continue this until you find it so thick as not to be able to draw it along with your stick; then pour it into a bowl, and let it cool.

Take also brick-dust finely powdered and sifted.

The miners find sometimes a matter in the iron mines which they call *liver-ore*; take this, and wash it from the coarser sand, and when dry, put it into an earthen pot; cover it, set it to neal thoroughly, and when cold, pound and sift it. When it is right burnt, it will be of a copper colour; put all these different powders into several boxes, and preserve them from dust and soil, for proper use.

To cast Vegetables and Insects.

FOUR parts of the above plaster of Paris, two parts of brick-dust, and two parts of liver ore; mix them well together, and sift them through a fine hair sieve; when you are ready to form your moulds, pour clean water to them, and stir them well together to the thickness of a thin paste; you must be pretty nimble with this work, else it will harden under your hands, and be of no use.

To prepare the Mould.

TAKE the plant you design to cast, and spread the leaves and stalks so as not to touch one another; then make a coffin, either of lead or clay, and put your plant in it so as not to touch the sides; at the bottom you may lay a piece of paper to keep the stuff from sticking to the board, but let your stuff be neither too thick nor too thin, for if it is of a right consistence it will force itself close to the plants and come out sharp; let the stalks be carefully kept up for the inlet; and when you pour this stuff upon your plants, do it gently, and separate those leaves which might lie close to one another with a needle, pouring all the while, to make the mould the stronger. After this is hardened, put it in a dry place, and keep it until you have some more ready to cast; but you must secure it from frost.

If you would cast insects, or any small animal, or reptile, put them, in what position you will, upon a little board, brown paper, or paste-board, which first must be anointed with oil, to make the plaster-stuff come off the easier; about your insect make a little coffin, and if you can raise the insect so as to be freed from the board or paper, it will be the better, which you may do by tying it with two or three hairs, and fastening them at the top of the coffin, by which it will hang in the middle; when this is ready, pour, as before directed, your plaster gently upon it, and after the mould is a little dry, it will be fit for use.

If you lay your insect, or other creature, upon the paper, you must make a wall about it, and cast your plaster upon it; let it stand a little, and when dry, take off your wall, and cut the plaster round about the insect, and taking the mould off the paper, there will be an opening at the bottom of the mould where the insect lies; turn this mould, and anoint it about the opening, and the part on the insect, with oil; then casting some fresh plaster upon that plate, your mould will take asunder, and be very convenient to draw out the ashes of the insect, after it has been burned, as is here directed.

Put your mould upon some warm wood-ashes; then cover it with small-coal; over the small-coal lay charcoal, and then fling some lighted small-coal over them, to kindle the others, so that the heat may be gently conveyed to the mould; and after it has glowed some time, and you think the insect or plant, is consumed to ashes, let it cool of itself, with the fire about it, to hinder the air coming to it. When your mould is cold, open an hole for an inlet, and, either with your breath, or with a little hand spout that is moist, draw out the ashes, and your mould is ready.

You may also burn the moulds in a muffel, if you close the muffel to prevent the air coming in, and lay the coals on and glow it as has been directed. After you have taken out the mould, put the same in warm sand, and having your silver, or other metal, ready melted, pour it in quick; but if you cast silver, fling into the flux a little sal-ammoniac and borax, mixed together. After it is cast, let the mould cool a little; then quench it in water, and the plaster will fall off of itself; brush the silver clean, and neal and boil it as has been already directed.

To cast Vegetables, or Insects, in another manner.

TIE your plant, sprig, or insect, with a fine thread, to a little stick; dip either of them into brandy, and let it dry a little; then temper your plaster of Paris, prepared as before directed, with water of sal-ammoniac, pretty thin, and dip you plant, or insect, in it all over; then put the little stick in the hole against a wall, or any thing else; let it hang free, and, in the drying, you may display the leaves of the plant, or legs of the insect, as you would have them; and when you have done this, hang it in the coffin (the little stick may rest on each end of the coffin); then, pouring your plaster over, you will have an exact mould; then proceed as directed before.

If you would have a small insect to stand upon a leaf, then dip the ends of its legs in turpentine, and put it on the plant before you dip it: if it is a spider, or grasshopper, or any other insect which you think will be too strong for the turpentine, kill it first in vinegar; and, after that, put its legs in the turpentine, and fix it to the leaf of the plant.

To cast Figures, or Medals, in Sulphur.

MELT (in a glazed pipkin) half a pound of sulphur over a gentle fire; with this mix half a pound of fine vermilion; when you have cleared the top, take it off the fire, and stir it well together, and it will dissolve like oil; then cast it into the mould, after being first anointed with oil; let it cool, and take it out; but in case your figure should change to a yellowish colour, you need only wipe it over with aqua-fortis, and it will look like the finest coral.

How to form and cast all Sorts of small Birds, Frogs, Fish, &c.

TAKE an earthen, iron, or tin ring, which is high and wide enough to hold the animal you design to cast, and set it upon a clean board, or paste-board; then lay the animal upon it, and cast the mixture of fine plaster pretty thick over it; the rest of the vacancy you may fill up with a coarser plaster, even to the brim: when this is done, and pretty well dried, turn your ring, and putting a little short stick close to the body of the animal, cast a crust on that side, to cover that part which before lay close to the board, and when dry, burn it, and go about the casting as directed: after you have burned it thoroughly, you must draw the ashes out at the hole which is made by the little stick, and this you may use for your inlet.

How to cast small Shot.

MELT your lead in a ladle; then pour it gently, in a continual stream, into a pan or pail of water, on the surface whereof swims oil of a finger thick; thus you will have good round small shot.

HOW TO CAST IMAGES OF PLASTER OF PARIS: TO CAST WAX, EITHER SOLID OR HOLLOW: ALSO TO FORM IMAGES IN WAX, AND CAST THEM AFTERWARDS IN ANY METAL, EITHER SOLID OR HOLLOW.

THE preparing the mixture for the moulds has been before shewn, for which reason it is needless to repeat it again.

If you will make a mould to cast an image, or animal in, take clean potters clay, and make thereof a coffin round about the image, which you lay long-ways on a board, and anoint it first over with oil; then take fine plaster of Paris; mix it with water, and pour it all over the image, so that it may cover it every way; then give it a stronger coat, with a coarser sort, and when the plaster is dry, take off the coffin, and cut that side which is cast something flat, making some notches or marks upon it; hen then turn it, and make a coffin about it again, and cast that side of the image, after you have anointed it with some oil all over, so that the whole may be entirely inclosed.

After the plaster has been a day or two upon the image, it will be quite dry; then, with a wooden mallet, beat cautiously against the plaster, till a piece thereof loosens, which being taken off, the rest will come off easy; and after you have dismantled the whole, anoint the inside thereof with linseed oil, with a fine hair pencil brush, and let it dry in; this do twice; after they have lain two or three days, cut in an inlet, where you think it most convenient; and, when you cast with plaster of Paris, before you do it, anoint the inside of the mould, and, after you have put all the pieces in their proper places and tied them together, cast your plaster, and let it stand half a day: take the pieces one after another carefully off, in order to keep the image intire; but if you will cast wax in that mould, put only the mould for half an hour before in water, and the wax will not stick to it. If you will have the image hollow, then mind that the wax be not too hot; pour it into the mould, and you will easily see how thick it sticks to it. When you think it is thick enough, then turn your mould about, and pour out the wax that is remaining, and after you have for a little while laid it in water, take off the pieces of moulding, and you will have the image done to perfection. You must observe, that before you break the mould from the image on which you formed it, you must mark it all over with crosses, circles, or strokes, by which you may afterwards fix them right and exactly together, to cast again. If you will have the wax figures solid, then let the mould with the images lie for half an hour, or more, to cool in fair water.

To

To prepare the Wax.

TAKE one pound of white resin that is not greasy, and two pounds of wax; melt the wax; strain it through a cloth into a glazed pan, and stir it about till it is cool.

To cast Medals and other things in Basso Relievo.

LAY your medal on a clean piece of paper, or a clean board; inclose it with a wall of clay or wax; then pour the plaster of Paris half an inch thick upon it; when it is dry, take off the mould, and anoint it with clear salad oil, two or three times, both within and without. If you will cast plaster of Paris, lay the mould first for a quarter of an hour in clear water; then cast your plaster as thick as you please.

You must observe that whenever you make a mould of plaster, let it be for basso relievo, or figures, you must always anoint it with oil, two or three times, which will not only preserve them from the damage they otherwise would sustain from the water, but make the cast pieces come out clear.

Medals and Figures in Basso Relievo, like Jasper.

To do this you must have a hand-spout, or a glyster-pipe, at the end whereof fix a tin or iron plate, full of round holes, some larger than others. In this spout put a paste, made of fine chalk of several colours; then force them out in small shreds of mixed colours in one piece; cut them with a fine edged knife in thin round slices, and put one into your mould, pressing it down gently; then pour the plaster of Paris upon it, and, when dry, lay it first over with fish glue, and after that varnish it, and it will be of singular beauty.

The colours you may first dilute with gum-water, before you mix the chalk with them.

Another.

TAKE the above-mentioned chalk paste, and, after you have mixed therewith a variety of colours, as smalt, white lead, vermilion, red lead, masticot, verdigrise, brown-red, &c. and formed each colour separate, into little cakes, then (with a rolling pin) spread them like pie-crust; when you have done as many colours as you think proper, lay one leaf upon another; roll them together from one end to the other, and, with a knife, cut slices as thin as a wafer; take these and cover your mould with; press it close down with your thumb, and pour the plaster of Paris over it; when dry, do it over with fish-glue, and then varnish it, or give it a polish with a dog's tooth.

To cast Fish, Reptiles, Fruit, or any kind of things, in a Pewter Plate, or Dish.

TAKE a pewter plate, or dish; garnish the same with fish, or reptiles, fruits, plants, &c. Dispose them in proper order, as your fancy directs you. Small animals, or leaves of plants, fasten to the dish with a little turpentine, and when every-thing is in order, wall it round; then pour your plaster of Paris over it; strike upon the table which the dish stands on, in order to make the casting fix the closer about the things; after the plaster is dry, make the mould for the back part of the dish; glow it, in order to burn the things to ashes; having cleared your mould, fix them together for casting, and tie them round with wires, and make them red hot; cast your pewter, and in order not to make the dish too heavy, convey some little openings from the back part of the mould to the body or hollow of the animals, stopping the outside close up again till your casting is over; and when you think the pewter sufficiently fixed, then open these conveyances and pour out the melted pewter which may remain, into an ingot.

If you would cast it in silver, then model your leaves, animals, &c. separate and hollow, that they may be afterwards soldered on.

To cast Figures in Imitation of Ivory.

TAKE isinglass and strong brandy; make it into a paste, with the powder of very fine ground egg-shells. You may give it what colour you please; but cast it warm into your mould, having oiled it all over; leave the figure in the mould till cold; then set them in the air to dry, and you will have them resemble ivory.

Another.

TAKE a sufficient quantity of egg-shells; put them into an earthen vessel; lute it well, and let them be put in a potter's furnace, and they will burn to a white calx; if, after the first burning they are not white enough, burn them a second time; then, with parchment-glue, mix it into a mass fit to be cast in moulds, wherein let them dry: if you will have your figures of different colours, you must colour your glue; for red, with brazil; for green, with verdigrise, &c.

Another Mixture to cast Figures in Basso Relievo.

TAKE flower of chalk, finely ground; mix it with clear glue well together; pour it into your mould; press it with the palm of your hand, and it will come out very fine: you may do this in what colour you please.

To Cast with Marble Colours in Plaster.

Take several colours, as vermilion, Dutch pink, yellow ochre, smalt, &c.: temper them with water, and mix every one apart with plaster: then take what colours you please, and, first sprinkling your mould, which is best of sulphur, with one or more of them, with a little pencil or feather; then pour a colour different from what you sprinkled into the mould, and after it is hardened, give it a gloss with wax or varnish, as pleases you best.

A Sand in which one may cast things to the greatest nicety, whether Flat, or in Basso Relievo.

Take fuller's earth; put it in a reverberatory furnace till it is red hot; then take sal-ammoniac, about one pound; dissolve it in two quarts of water; with this water moisten the burnt earth, and, when cool, put it into the furnace in a red-hot pan; after it has glown there, take it out again; when the heat is a little over, sprinkle it with the above water again, till it is quenched; then give it another fire, and repeat this five or six times; the more, the better it will receive the metal: grind it to a very fine powder; put it into the frame, which may be either of brass, iron, or wood, but first moisten it a little with the aforesaid water; then make your impression, near the ingot, and having dried it before the fire, while it is hot, cast your metal; the mould or impression will be better the second than the first time using it, but every time you use it, make it first red-hot.

To make Horn soft.

Take one pound of wood-ashes, two pounds of quicklime, one quart of water; let it boil together to one third;

then dip a feather into it, and if, in drawing it out, the plume comes off, it is boiled enough; if not, let it boil longer; when it is settled, filter it through a cloth; then put in shavings, or filings, of horn; let them soak therein three days; and, anointing your hands first with oil, work the horn shavings into a mass, and print, mould, or form it in what shape you please.

To cast Horn into Moulds.

Take horn shavings as many as you will, and lay them in a new earthen pot; take two parts of wood-ashes, and the third part of lime; pour clear lye upon it, so as to cover it all over; boil it well; stir it with an iron ladle, till it has the consistence of a paste: if you will have it of a red colour, then take red lead, or vermilion, as much as you think proper, and temper it with the paste; then cast it into a mould, and let it dry: you may smooth it with a knife, and it will be of one solid piece; you may in this manner bring horn to what colour you will have it.

To cast Wood in Moulds, as fine as Ivory, of a fragrant Smell, and in several Colours.

Take fine saw-dust of lime-tree wood; put it into a clean pan; tie it close up with paper, and let it dry by a gentle heat; then beat it in a stone mortar to a very fine powder; sift it through cambric, and lay it, if you do not use it presently, in a dry place, to keep it from dust.

Then take one pound of fine parchment glue; the finest gum-tragacanth and gum-arabic, of each four ounces; let them boil in clear pump-water, and filter through a clean rag; then stir into it of the aforesaid powder of wood; add till it becomes of the substance of a thick paste, and set it in a glazed pan in hot sand; stir it well together, and let the rest of the moisture evaporate till it be fit for casting. Then pour, or mix, your colours with the paste, and put in oil of cloves, of roses, or the like, to give it a scent; you may mix it, if you will, with a little beaten amber: for a red colour, use brazil ink; and for other colours, such as will be directed under the article for bookbinders. Your mould will be better of pewter, or brass, than of plaster of Paris; anoint it over with oil of almonds, and put your paste into it; let it stand three or four days to dry and harden; then take off your mould, and it will be as hard as ivory; you may cut, turn, carve, and plane it like other wood; it will be of a sweet scent; you may, if your mould will allow it, use several colours in one piece, leaving only in some part the natural colour of the wood, in order to convince the beholder what it is. It is a fine and curious experiment.

MIXTURES FOR CASTING MIRRORS, AND FOR CASTING OTHER THINGS.

Receipts for preparing these mixtures are prescribed by several authors, after different ways; wherefore I shall set down only a few, that for the generality are best approved of: and first,

For reflecting Mirrors.

Take three pounds of the best refined pewter, and one pound of refined copper. First melt the copper, and then add the pewter to it: when both are in fusion, pour it out, and, when cold, beat it to powder: then take twelve ounces of red tartar, a little calcined tartar, three ounces of nitre, one ounce and a half of alum, and four ounces of arsenic: mix and stir these together,

gether, and, after it has done evaporating, pour out the metal into your mould; let it cool; and when polished you will have a fine mirror.

This is the composition which is commonly called the steel mixture.

Some artists will have the arsenic omitted, because it is apt to turn the mirror to a deadish blue colour, and requires new polishing every time it is used; and they think that copper and pewter are sufficient to answer the purpose of a mirror without it.

Another.

TAKE an earthen pan that is not glazed, and has stood the fire; put into it two pounds of tartar, and the same weight of crystalline arsenic, and melt them on a coal fire. When this mixture begins to smoke, add to it fifty pounds of old copper, and put it into fusion for six or seven hours, so that it may be well cleansed; then add to it fifty pounds of pewter, and let them melt together; after this, take up some of the mixture with an iron, to see whether it is too hard and brittle; if so, then add a little more pewter; and when you have the right temper, fling four ounces of borax over it, and let it stand in the furnace until it is dissolved; then pour it into your mould and let it cool; when it is cold, rub it first with brimstone and then with emery; and after the surface is made smooth and even, polish it with tripoly or tin ashes, and give it the finishing stroke with lamp-black. *Or,*

TAKE copper one part, pewter three parts, and a very little arsenic or tartar; when these are put into fusion let them incorporate.

Some take of copper three parts, of pewter one part, and a little silver, antimony, and white flint.

Others do it with one part of lead, and two parts of silver.

After the metal is formed and cast, it is requisite to have it smooth and well polished: the first is done with emery, and then with powdered sulphur or tin ashes, or else with tripoly: the polishing is done with pulverized chimney soot of wood fires, and the ashes of willow, or cedar, which will give it a fine lustre: the emery is ground to a fine dust, and moistened with water. *Or*,

Steel mixtures are also made out of one pound of pewter, and one third of copper; when these are melted, add two ounces of tartar, and one ounce of orpiment, and, when evaporated, pour the mixture out into the mould. The casting of a flat mirror, or looking-glass, is done upon a flat board, with a little edging all round it, made dry and warm, and covered with resin or pitch; by this means the mirror is fixed to the board: when cold, rub it with sand and water, then with emery, or flower of brimstone, and at last polish it with tin-ashes, *i. e.* putty.

Another sort of Steel Mixture for Mirrors.

TAKE good new copper, of that sort which is used for copper wire, eight parts; fine *English* pewter one part; bismuth five parts; put them together into a crucible, and melt. Grease your mould all over with tallow, in order to cast your metal into it, when it is in fusion; dip a hot iron into it, and what sticks to it let cool: if the colour is inclining to white, it is right; but if to red, you must add some more pewter, until it has its right colour: observe, that whatever you put to the melted metal must first be made hot. After this manner you may form and cast whatever you please. *Or*,

Melt one pound of copper; fling into it eight ounces of spelter*, and when the spelter is in flame, stir it with a stick, or hot iron rod, well together: then add five or six ounces of fine pewter to it; pour it into your moulds; smooth and polish it as has been directed above, and you will have a fine and bright mirror.

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* Spelter is another name for zinc.

PETER SHOT's *Metallic Mixture for Mirrors.*

TAKE ten parts of copper; melt them, and add four parts of fine pewter; strew upon the mixture a small quantity of pulverized antimony and sal-ammoniac; stir it well together until the stinking smoke is evaporated; then pour it out into the moulds: first smooth it in sand and water, and then proceed as has been directed.

Mixtures for mirrors are made different ways: copper is the chief ingredient, which must be tempered with a whitish metal, in order to bring the objects that are seen therein to their natural colour; and this is done by pewter and arsenic.

To cast a flat looking-glass, it will be best to have two polished stones for a mould; between these two stones put, at each end, an iron wire, as thick as you would cast your mirror; then tie the stones close, and fill the crevice round about them with putty, leaving only an opening, or hole, to pour the metal in. When that is dry, and the stones are made thoroughly warm, pour the metal in: when it is cold, smooth and polish it as directed above. You may fasten the one side to a flat stone with plaster of Paris, and polish the other with a smooth stone; and last of all, give it the finishing stroke with a piece of old hat and fine tin ashes.

If you would cast a concave mirror, or burning-glass, let your mould be exactly turned; but if you cannot get it conveniently done, you may take a truly turned bowl, and wet it, and proceed thus:

Make a crust of wax; roll it with a wet rolling-pin to what thickness you would have your metal cast; and to have it of an equal thickness, you may fix a couple of rulers on each side for your rolling-pin to play upon: then cut this crust of wax into a circle, and form it upon the outside of your wet bowl, and set it in a cool place to harden. In the meantime prepare a fine clay, by washing and pouring it out of one pan into another; take the finest of the settling, and get it burnt in a potter's furnace to a reddish colour. When this is done, grind it with sal-ammoniac, sublimate, and rain water, upon a marble, very fine, and to such a consistence that it may be laid on with a pencil, like painters colour: with this paint the outside of the wax mould over, and let it dry in the shade; when dry, lay on a coat of haired clay, of about two fingers thick, and let this also dry in the shade. Then take it off the bowl, and lay the concave side uppermost, and do as above, viz. lay with a soft hair pencil the prepared and burnt clay all over; and when dry, lay it over with haired clay, so as to cover the whole mould of wax; the hole at which you design to pour in your metal you may open after it is dry. Then fix the mould, with the hole downwards, upon a couple of iron bars, or a couple of bricks, making a charcoal fire underneath and round the sides of it, that the wax may melt and run out at the hole: you may catch some of the wax, and set it by for other uses. When thus the mould is cleared of the wax, and is still hot, turn it up, and set it in warm sand, and put warm sand round about it to the top, to keep it firm; then put an earthen ware funnel into the hole, and pour in the metal; as soon as you are about to pour, fling into the metal a rag dipped in wax, (which keeps its melted surface from calcining) and, whilst it is in flame, pour the metal into the mould: after the metal in the mould is cold, polish it carefully, so as not to take more off in one place than in another, for, if you do, it will prove a detriment to the mirror.

The polishing is best done after the braziers manner, *viz.* with a wheel, to which is fixed a rough sand stone, to take off the coarse crust; then with a fine stone and water, make it smooth; and then with a wooden wheel, covered with leather, and laid on with emery, polish it from all the streaks or spots, giving it the finishing stroke with fine tin-ashes and blood-stone in powder, which you apply to the wheel that is covered with leather: continue this until it has a perfect gloss. Keep it in as dry a place as possible, to prevent its tarnishing; but if it should tarnish, you must polish it again with a piece of buck-skin, dipped in fine washed tin ashes. After the same manner you may also polish the concave side of the mirror.

An uncommon Way of preparing a Mirror-mixture on Brass.

TAKE strong distilled white-wine vinegar, one pound; fine sal-ammoniac four ounces; quicksilver four ounces; let this boil upon hot sand until the third part of the vinegar is boiled away; (this liquor is the principal ingredient for the work;) then take a brass plate; polish it very bright with some coal dust, and lay it in an iron pan, on a gentle coal fire; when it is pretty hot, dip a rag into the liquor, and rub your plate with it for an hour together; and this lays the foundation for what follows. Make a paste, with one part of quicksilver, and two parts of soap-tin*; in this dip your rag, and rub it upon the plate of brass until you have a looking-glass colour.

These plates, thus prepared, lay in the iron pan upon a coal fire until you see they begin to turn to a reddish colour, which they will do in about a minute's time; with this colour the mercury flies away, and the tin colour remains on the plate; then let it cool, and take a little prepared emery upon a piece of leather, and rub the plate over with even strokes, but not too long, for fear of rubbing the tin from the brass. You may, instead of with emery, polish it also with tripoli.

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* SOAP-TIN is not a common appellation. It may mean, probably, an amalgam, of tin-foil and quicksilver, such as is now used on mirrors: or, soap may be required to be added. *Ed.*

N. B. If the tin should make the plate too white, you may use lead instead of it, making a paste with that and mercury, and proceed as above.

By this means you may make what figures you please.

To cast Iron.

TAKE clean filings of iron; wash them in lye, and then water; mix them with as much powder of sulphur; put the mixture into a crucible, and give it a strong fire until it is in fusion: if you manage it right, it will cast clean and smooth.

To caſt Steel.

TAKE of the best and finest steel, about one pound, break it into bits; put it in a good strong crucible, and neal it to a bright red colour. Then add sixteen or twenty-four ounces of good common steel, and neal it thoroughly: add then eight or ten ounces of * *arsenic glass*, give it a violent fire, and it will melt and flux: with this composition you may cast what you please.

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* *To prepare the arsenic glass*: take one pound of white arsenic, and two pounds of good nitre; put them into a new pot that is not glazed, with a cover that has a little round hole in the middle; lute it well all round, then let it dry, and when dry, put the pot in a reverberatory fire for three hours, and there will evaporate out of the hole of the cover a red poisonous fume; which you must take care of, and keep at some distance from it. The second hour, move the fire nearer the pot; and when the fumes cease, close the hole with some clay: At the third hour put the coals close to the pot,

To cast Iron as white as Silver.

TAKE tartar, nitre, arsenic, and clean steel filings, of each an equal quantity; put them together into a crucible, on a charcoal fire; when in fusion, pour the mixture out into an ingot, and you will have, out of one pound of steel filings, about two or three ounces of a white bright mass; clear the top of the dross, and preserve the mass for use.

Another Method.

TAKE tartar, oil, and a little fixed nitre, *i. e.* purified potash, and mix these into a paste: then put iron, or steel filings into a crucible; set it on a charcoal fire; fling the mixture upon it, and it will dissolve and come out like silver: but it is brittle, and apt to break. *Or*,

Take calcined tartar, and mix it with oil; of this take two ounces, and steel filings six ounces; put them together into a luted crucible, and set them in a wide furnace until you think they are melted; then open the crucible, and make a fierce fire until you see the mixture rise; then take it off the fire; clear it from the dross, and cast it into an ingot of what shape you please, and it will be of a white colour.

pot, and give it a thorough heat: then let it cool of itself, and at the opening of the pot you will find a white, sometimes a greenish-white, stone, which put up in a dry warm place free from the air, to prevent its melting: of this you are to take five ounces, and of borax three ounces; grind well together, and let it melt in a large crucible until it is fluid; pour this into a refining cup, and you will have a fine transparent matter: what is not used, you may preserve from the air, to keep it from dissolving.

How to take Impressions with Ising-glass, from Copper-plates.

TAKE fine white ising-glass, as much as you please; cut it fine, and put it into a glass, or cup; pour on it so much brandy as will just cover the ising-glass; close it well, and let it soak all night; then pour some clear water to it, and boil it on a gentle coal fire, until a drop of it put on a knife is like a clear jelly; strain it then through a cloth, and put it into a cool place; where it will jelly, and be ready for use.

When you are about casting a picture, cut so much of the jelly as you think you have occasion to cover the copper-plate with; dissolve it in a clean pipkin, or such like utensil, over a slow coal fire, and mix any of the colours, to be hereafter mentioned, amongst it; mean while, your copper-plate must be cleaned; then wipe the plate carefully with clean hands, as the copper-plate printers do; and when this is done, pour your dissolved ising-glass over it, but not too hot, spreading it with a pencil very even every where until your copper-plate is covered: set it then in a moderate warm place to dry; and when you perceive it thoroughly dry, then, with the help of a thin blade of a knife, you may lift it up from the plate; if you find the matter has been made too thin, add more ising-glass to it; but if too thick, add a little more water, and boil it again.

Of the Colours fit to be mixed with Ising-glass, for Impressions of Plates.

1. FOR red; mix with it some of the liquid in which you have boiled scarlet rags.

2. For blue; take litmus, dissolved in fair water, and mix it.

3. For green; take distilled verdigrise; grind it as fine as possible, and mix it.

4. For yellow; steep saffron in fair water, and mix it.

5. A gold colour is made with the above red and saffron-yellow.

6. Gold, silver, or copper, separately well ground, as for painting, may be severally mixed with the materials, and poured quickly over the plate. If you first rub printers black in the graving, the gold and silver will look the better.

To cast Plaster of Paris on Copper-plates.

First rub the colour, either red, brown, or black, into the graving, and wipe the plate clean; then mix as much plaster as you think you shall have occasion for, with fresh water, to the consistence of a thin paste, and having put a border round the plate, of four pieces of reglet*, pour the plaster upon it, and move it so as that it may run even all over the plate: let it stand for an hour, or longer, according to the dimensions of the plate, and when you find it dry, and turned hard, take off the reglets, and then the plaster, and you will have a fine impression of the copper graving. You must observe not to mix more at a time than you have occasion for, else it will grow hard before you can use it.

A Mixture which may be used for making Impressions of any kind, and which will grow as hard as Stone.

Take clean and fine sifted ashes, and fine plaster of Paris, of each an equal quantity; temper the mixture with gum-water, or with size of parchment; knead it well together, and press it down into your mould; but do not prepare more than what you use presently, else it will harden under your hands. You may give it what colour you please; for black, take lamp-black; for red, vermilion; for white, flake-white; for green, verdigrise; for yellow, *Dutch* pink, &c. severally mix with the composition.

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* A *reglet* is a ledge of wood used by printers. *Ed.*

You may, instead of gum or size, use the whites of eggs, which is more binding.

To impress Figures in Imitation of Porcelain.

CALCINED and fine pulverized egg-shells, worked with gum-arabic and the white of eggs into a dough, and then pressed into a mould, and dried in the sun, will come out sharp, and look fine.

PART VI.

A COLLECTION OF VERY

VALUABLE SECRETS

FOR THE USE OF

SMITHS, CUTLERS, PEWTERERS, BRAZIERS, BOOKBINDERS, JOINERS, TURNERS, JAPANNERS, &C.

CHOICE EXPERIMENTS ON IRON AND STEEL.

To harden Sword-blades.

SWORD-BLADES are to be made tough, so as not to snap or break in pushing against any thing capable of resistance; they must also be of a keen edge; for which purpose they must all along the middle be hardened with oil and butter, to make them tough, and the edges with such things as shall be prescribed hereafter, for hardening edged instruments. This work requires not a little care in the practice.

How to imitate the Damascan Blades.

THIS may be done to such perfection that they cannot be distinguished from the real Damascan blades. First polish your blade in the best manner, and finish it by rubbing it with flower of chalk; then take chalk mixed with water, and rub it with your fingers well together on your hand; with this touch the polished blade, and make spots at pleasure, and set them to dry before the sun, or a fire; then take water in which tartar has been dissolved, and wet your blade all over therewith, and those places that are left clear from chalk will change to a black colour; a little after, wash all off, with clear water, and the places where the chalk has been will be bright.

How the Damascan Blades are hardened.

THE *Turks* take fresh goat's blood, and after they have made their blades red hot, they quench them therein; this they repeat nine times running, which makes their blades so hard as to cut iron.

To perfume a Sword-blade, so as to retain always an odoriferous Scent.

TAKE eight grains of ambergrease, four grains of musk, grind them together with a little sugar-candy, in a glass or agate mortar; after this add to the mixture four scruples of the best oil of benjamin, and mix it well together; then hold the sword blade over a gentle, clear, charcoal fire, and when the blade is well heated, dip a little spunge in the forementioned mixture, and wipe your blade all over; though you do this only once, yet the odoriferous scent will remain, although the blade was to be polished again.

To harden Steel and Iron, which will resist and cut common Iron.

TAKE shoe-leather, and burn it to a powder, the older the leather is the better it is for use; salt, which is dissolved, and glass-gall powdered, of each an equal quantity; then take what you desire to harden and wet it therewith, or lay it in urine, and taking it out, strew it over with this powder, or else stratify it therewith in an earthen pan; give it for five hours a slow fire to cement, and make it afterwards red hot for an hour together.

To temper Steel, so as to cut Iron like Lead.

TAKE the steel; then distil from earth-worms, in an alembic, a water, which mix with an equal quantity of the juice of radishes; in this liquid quench the steel, blades of knives, daggers, swords, &c. and they will be of an excellent temper.

Several other Temperings of Steel and Iron.

1. IRON quenched in distilled vinegar, or in distilled urine, becomes of a good temper.

2. Vinegar, in which sal-ammoniac has been dissolved, gives it a good temper.

3. So does the water in which urine, salt, and saltpetre have been dissolved.

4. Mix together an equal quantity of saltpetre and sal-ammoniac, and put the mixture into a phial with a long neck; then set it in a damp place, or in horse dung, where it will turn to an oily water; this liquor will make iron works of an incomparable temper and hardness, if quenched therein red hot.

5. A lye made of quick-lime and salt of soda, or of pot-ash, filtered through a linen cloth, gives a very good hardness to iron, if quenched therein.

6. The dung of an animal which feeds only on grass, mixed with water and calcined soap to a thin paste, gives such a good temper, as to make it cut untempered iron.

7. Or take *Spanish* radishes, grate them on a grater, and express their juice; this gives a good temper to iron or steel quenched therein.

8. Take the juice of nettles, fresh urine, ox-gall, salt and strong vinegar, equal quantities of each; this mixture gives an incomparable temper.

9. Red hot iron or steel, wiped over with goose grease, and then quenched in sour beer, takes also a good temper.

A particular Secret to harden Armour.

Of the following take an equal quantity; common salt, orpiment, burned goat's horn, and sal-ammoniac; powder and mix them together; then anoint the armour with black soap all over, strew this powder upon them, and wind a wet rag about them, and lay them in a fierce charcoal fire, till they are red hot; then quench them in urine. If you repeat it, it will be the better.

To temper Steel or Iron so as to make excellent Knives.

Take clear steel, quench it in distilled rain, or warm water, and the juice of *Spanish* radishes; the knives made of such steel will cut iron.

Another Method.

Take black or *Spanish* radishes; grate them on a grater; put salt and oil upon them, and let them stand two days. Then press the liquor out, and quench the steel or iron several times in it, and it will be very hard.

To bring Gravers and other Tools to a softer Temper.

Take a little pan with live charcoal, and put a couple of old files, or any other small bars of iron over it; then lay your gravers upon them, and when you see them change to a yellowish colour, it is a sign that they are softer; after this colour they change to a reddish, which shews them still softer; and if you let them turn to a blue, then they are quite soft and unfit for use: after this manner you may soften any steel that is too hard.

General Rules to be observed in tempering of Iron or Steel.

We know by experience, that the tempering of iron may be performed and executed several ways; for every mechanical branch requires a particular method of hardening. The tools that are used for wood, require a different temper or hardness from those used in cutting of stone or iron, and therefore are prepared, according to the several methods treated of before: an artist ought to acquaint himself with the powers of the different ingredients and liquors that are here prescribed, and improve upon such as seem most promising. He is to observe the degrees of heat, which he is to give, and the length of time he is to keep the metal in the liquor for quenching; for if the iron be made so excessively hot that it is not capable of receiving a greater degree of heat, it cannot well be quenched, and it will become cankered; but if it appears of a saffron or reddish colour, it is called gold, and is fit to be quenched, for hardening: however, in this, as well as most other things, practice is the best instructor.

A curious Method of hammering Iron without Fire, and making it Red Hot.

Take a round iron, about an inch thick; at one end thereof fix a round iron knob; then begin gently to hammer it under the knob, turning it quickly round; and by following your strokes harder and harder, the iron will heat of itself, and begin to be red hot; because the knob keeps the heat, on each of the motions, from passing off.

To soften Iron or Steel that is brittle.

1. ANOINT it with tallow all over; neal it in a gentle charcoal fire, and let it cool of itself.

2. To neal it, as above, with human excrement, softens it; but you must keep it in the fire for two hours.

3. Or take a little clay, lime, and cow's dung; cover your iron with it, and neal it in a charcoal fire: then let it cool of itself.

4. Or, make iron or steel red hot, and strew upon it good hellebore, and it will become so soft that you may bend it which way you please: this is very useful for those who cut in iron or steel.

5. Take lead, put it into a crucible, or iron ladle, and melt and pour it into oil; this repeat seven times running. If you afterwards quench iron or steel in this oil, it will be very soft; and after you have shaped or worked it in what manner you please, you may harden it again by quenching it in the juice of onions.

6. Take lime, brick-dust, and *Venice* soap; with this anoint your steel, and neal it; then let it cool of itself.

7. Take the root of blue lilies; cut them fine; infuse them in wine, and quench the steel in it.

8. Wind about the steel some thin slices of bacon, and over that put clay; let it neal for an hour, and the steel will be very soft.

9. Take quick-lime and pulverized soap, of one as much as the other; mix together, and temper it with ox's blood; with this anoint the steel; then lay a covering of clay over it; and let it neal and cool of itself.

10. Take the juice or water of common beans, quench your iron or steel in it, and it will be as soft as lead.

A particular

A particular Powder and Oil, to take off Rust and Spots from Iron, and to preserve it from Rust for a long Time; very useful in Armories.

The Powder.

TAKE two pounds of crucible powder, of such as is commonly used for refining of silver, and sift it through a fine hair sieve: then take four pounds of emery, and one pound of silver ore; pound them all very fine, and sift them; put at last fine beaten scales of iron to them, and the powder is fit for use.

The Oil.

TAKE three pounds of *Lucca* oil, and put it into an iron pot; then take three pounds of lead, melted, and pour it into the oil; take it out, and melt it again, and repeat melting and pouring several times; the oftener the better the oil will be*. After you have done this, and the heat of the lead has extracted both the greasiness and salt of the oil, take the lead out, and put the oil into a glass; fling three pounds of filings of lead into it, shake it well together; pour it afterwards on a colour stone, grind it together as painters do their colours, put it again into the glass, to preserve it for use: the lead will sink to the bottom, and the oil swim at top, which you may use in the following manner.

Take some of it in a bit of cloth, on which there is some of the before-mentioned *Powder*, and rub the rust of spots, upon armour, or any other iron work, therewith, and it will take it clean off; if, afterwards, you anoint the armour or iron work with clear oil, it will keep from rust for a long time.

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* Litharge is now used in a similar intention, to make the oil of a drying quality; for it is merely a drying oil. *Ed.*

N. B. The emery which is used among the other ingredients of the powder, must be first calcined.

Another Oil.

FRY a middling eel in an iron pan, and when brown and thoroughly fried, express its oil, and put into a phial, to settle and become clear in the sun. Iron work, anointed with this oil, will never rust, although it lay in a damp place.

TO ETCH UPON SWORD OR KNIFE-BLADES.

To prepare the Etch-water.

TAKE mercury and aqua-fortis, put them together into a glass, till the mercury is consumed, and it is fit for use.

To make the Ground.

TAKE three ounces of red lead, one ounce of white lead, half an ounce of chalk, all finely pounded; grind these together with varnish, and anoint your iron; let it dry in the sun, or before a slow fire, and with a pointed steel, or needle, draw or write on it what you please; and then etch it with the above prepared water.

Another Water to etch with.

TAKE two ounces of verdigrise, one ounce of burnt alum, and one ounce of dissolved salt: boil this mixture in one quart of vinegar, till it is half boiled away; and when you are ready to etch, warm, and pour it with a spoon, or glass cup, over your work; hold it over the fire to keep it warm, and repeat this till you find it etched deep enough.

To etch 100 *or more Knife-blades at once.*

GRIND red lead with linseed oil or varnish; with this wipe your blades all over, and let them dry well, and harden; then write, or draw, with a pointed bodkin, whatever you will: then put them at some distance from each other, into a glass or well glazed pot or pan; dissolve some vitriol in hot water, pour it over the blades, and lute the glass or pot; set it over a gentle coal-fire; let it boil for some time, and then let it cool; then take your blades out; scrape the red lead off, and you will find the etching to your satisfaction.

To make Blue Letters on Sword-blades.

TAKE the blade; hold it over a charcoal fire till it is blue; then, with oil colours, write what letters you will upon the blade, and let them dry; when dry, take good strong vinegar; make it warm, and pour it all over the blade; this will take off the blue colour; then wet your oil colour with fresh water, and it will come off easily, and the letters drawn therewith remain blue.

To harden Fishing Hooks.

AFTER you have (of good wire) made your small fishing hooks, you must not put them into the fire to harden, but lay them upon a red hot iron plate; and when they are red, fling them into water; take them out again, and when dry, put them again on the hot iron plate, and when they appear of an ash-colour, fling them again into cold water; this will make them tough, otherwise they will be brittle.

To gild upon Iron or Steel.

TAKE common salt, saltpetre and alum, an equal quantity of each; dissolve them in as little warm water as possible; then filter them through whited brown paper; add leaf gold, or rather thin beaten gold, to it, and set it on hot sand, to make it almost boiling hot; keep it in that heat for twenty-four hours, and if the water evaporate, you may supply it with more; but at last let it all evaporate, and it will turn to a yellow salt; this pulverize; put it into a glass, and cover it with strong brandy, or spirit of wine, two inches high above the powder: then stop your glass close, put it into a gentle warmth, and the brandy, or spirit, will extract all the gold, and be of a beautiful colour. With this water you may, with a new pen or pencil, write or draw what you please upon a sword-blade, knife, or any other thing made of iron or steel, and it will be gilded to a high colour.

A Ground for gilding Steel or Iron.

TAKE five ounces of vitriol, two ounces of gall-stone, two ounces of sal-ammoniac, one ounce of feather-white, and a handful of common salt: beat all this together until it is fine, and mix it well; put it into a glazed pipkin, add to it a quart of water, and give it a quick boiling; then take a knife, or any other iron that is clean, and stir it about; if it is of a copper colour it is right, but of a red colour it is better.

If you have a mind to gild with this ground, put your steel on a slow fire, and make it so hot that you cannot bear it in your hand; then take your ground, and dipping some cotton into it, wipe the steel with it; take afterwards quicksilver, and wipe your ground over; then take the prepared gold, and lay it on such places as you would have gilded; after you have done this, lay it on a charcoal fire until it turns yellow; then wipe it over with tallow; and take cotton to wipe your blade, holding it all the while over the fire until it inclines to a black; rub it with a woollen cloth, until that colour vanishes; and rub it again with chalk, until you bring it to a fine gloss. If you would have the ground brown or blue, hold it over the fire until it turns either to the one or the other colour; then wipe it over with wax, and polish it with chalk.

OF LEAD AND PEWTER.

To make Pewter hard.

TAKE one pound of common pewter, and let it melt in an iron pan; add to it some salad oil, let it evaporate well, and stir it continually, keeping the flame from it; add some fine wheat flour, and stir it well about; then take all the burnt matter off the top, and to each pound add three or four ounces of plate brass, filed small, and mixed with oil, and a few ounces of pulverized bismuth, or regulus of antimony; stir it all the while, and when all is melted and incorporated, you will not only have a pewter that is harder and whiter, but also different in its sound from common pewter. *Or,*

Melt tin in an iron pan, strew colophony, or common resin, with fine wheat flour mixed together, into it; and stir it gently about; this takes off the blackness, and makes it of a fine white colour.

If you will have it hard, add to each pound of tin one or two ounces of pulverized regulus of antimony, this makes it white and hard, and gives it a clear sound.

Another Method to make Pewter as White as Silver.

Take clean copper one pound, and let it flux; add to it of the best English pewter one pound, and continue the flux; to this add two pounds of the regulus of antimony, and let it still flux for half an hour; then cast it into an ingot. Beat this in a mortar to a fine powder, and fling thereof as much into melted tin as you think requisite: you will find it (after you cast it) of a fine silver colour; it will be hard and give a fine sound: to make it flux the better, you may add a little bismuth. *Or,*

Melt one pound of copper, add to it one pound of tin, half a pound of zinc, one pound of regulus of antimony; let them flux for half an hour, and cast them into an ingot.

N. B. There are many more secrets relating to whitening and hardening of pewter. It is found by experience, that the regulus of antimony will make it continue white, hard, and of a good sound.

To make Tin, or Lead, Ashes.

Take which sort of these metals you will; let it melt; and fling well dried and beaten salt into it; stir it well together with an iron ladle, or spatula, until it separates and forms itself into a powder. *Or,*

After the tin or lead is melted, pour it into fine dry salt, stir it together until it is fit for sifting: then put this powder into a pan of clean water, and stir it; pour off the first water, and put fresh to it; repeat this until the water comes off clear, and without the taste of any salt. The remaining powder put into a melting pot; set it in a reverberatory furnace; stir it well together, and you will have fine white tin ashes.

A Gold Colour upon Lead or Tin.

TAKE saffron, as much as you will, and put it into strong gum-water; add to it a third part of vinegar, and let it soak over night; then mix it with a little clarified honey; stir it well together, and let it boil until it comes to the consistence of honey; strain it afterwards through a cloth, and it is fit for use. *Or,*

Take linseed oil skimmed over the fire, and add powdered amber and hepatic aloes, of each an equal quantity; set it over the fire, and stir it until it its thick; then cover it all over with earth, for three days. If you anoint your tin or pewter with it, it will have a fine gold colour.

A Water to be used in Tinning all Sorts of Metals, especially Iron.

TAKE one ounce of fine pounded sal ammoniac, and put it into very sour vinegar; when you would tin iron, wash it first with this vinegar, and strew beaten resin over it; dip it into the melted tin, and it will come out with a fine and bright lustre.

To make Tin which shall have the Weight, Hardness, Sound, and Colour of Silver.

TAKE fine crude crystal antimony; beat it fine, and wash it in water until it becomes sleek, and let it dry again.

Then take well dried nitre and tartar, of each an equal quantity; beat them fine, and put them together into an earthen pan, on which lay some live charcoal, and the nitre and tartar will soon begin to fulminate; then cover the pan with a lid; let the matter burn out and cool, and you will find a yellow salt: this salt beat to powder, before it is quite cold, and put thereof, into a crucible, one pound, and of the washed antimony two pounds. Mix them well together, and let it flux in a wind furnace for three quarters of an hour: then fling a little lighted small coal into them, and let them consume, and stir them well together with a stick. Presently after, take the crucible out of the fire; beat it a little down to the bottom, and let it cool of itself; then break the crucible, and you will find a silver-coloured regulus of three quarters of a pound weight.

Then take two pounds of old copper; cut it fine; neal it, and quench it, ten times running, in very strong lye made of the above tartar and rain water. Take it, while wet, and put it into a crucible, with one pound of fine beaten arsenic, *stratum super stratum*. When all is in the crucible, pour as much linseed oil on it as will cover the matter; then cover and lute your crucible; put it into a new pan; fill it all round with sand, and set it three hours in a circular-fire: after it is cold, open it, and you will find the copper spungy and of several colours. Of this take two pounds, and plate-brass two pounds; melt these together; add, by degrees, the copper, and give it a quick fusion in a wind furnace; then add two pounds of English pewter, half a pound of bismuth, and two pounds of the above regulus; let it flux well: then pour it out, and you will have a fine silver mixture. Beat this into a fine powder; mix it, with linseed oil, to a paste, and with a spatula add it to melted pewter; stir it well together, and you will have a fine tin, which will resemble silver exactly.

To make Tin flow easy.

TAKE resin and nitre, of each an equal quantity; beat them to powder, and strew them upon the tin, when in fusion.

A particular Method to make Tin resemble Silver.

MELT four ounces of fine plate-brass, add to it four ounces of fine clean tin, and when in fusion, add four ounces of bismuth, and four ounces of regulus of antimony; let these flux together, and pour it out into an ingot; then beat it to powder; grind it with resin, and a little sal-ammoniac, and with turpentine form it into balls; let them dry in the air; when you would use them, beat them fine, strew the powder thereof upon the melted tin, stir it well together, and continue putting the powdered balls upon the tin, until you perceive it white and hard enough: of this tin you may draw wire, for hilts of swords, or to make buttons; it will always retain its silver colour.

Solder, to Solder Tin with.

TAKE tin and lead, of each one ounce; bismuth two ounces; melt these, and pour them over a plate, to cast them thin: with this you may solder over a candle, or a small charcoal fire.

Another Solder, for Pewter.

TAKE resin and oil; let them melt in a spoon, and fling into them a little devil's dung *; then pour them out, and having new filed the two pieces to be joined, anoint them with the resin; dust some fine filed tin over it, and hold it over a coal-fire, and when it flows, take it off and let it cool.

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* Asafœtida is sometimes called by the name of *Devil's dung*. *Ed.*

To make Tin Coat-buttons, in Imitation of worked Buttons of Gold and Silk.

TAKE lamp-black; grind it with oil of spike, and mark the ground-work with a pencil; when dry, draw it all over with the varnish before described *: the best way to imitate worked buttons is, to do them in a fine mould, either stamped or cast; the ground is first filled up with black, blue, red, or any other colour; then the raised part is to be wiped very clean, and when dry, to be drawn over with the varnish, which will make it look much finer than what can be done upon a plain button.

For a brown colour take umber.

For green take distilled verdigrise, mixed with other colours, to make it either deeper or lighter.

For grey take white lead, and lamp-black.

All your colours must be ground with oil of spike.

In this manner you may embellish pewter, with a coat of arms, cypher, or ornaments; that is, such pewter things as are not to be scowered.

The Art of making Tin Plates, or Latten.

THERE are only certain sorts of iron which can be reduced into leaves or sheets for that purpose; the best is that which, when heated, is easiest extended, and can be forged with a hammer when cold: the more soft and exceeding flexible, as well as the more brittle, are to be rejected. These leaves are drawn from bars of iron about an inch square, which, being made a little flat, they cut into thin pieces, and fold them together into parcels, each parcel containing about forty leaves, which they batter all at once with a hammer of six or seven hundred pounds weight. After this, the principal of the art is to prepare these leaves; for the least dust, or rust, upon their surface, will hinder the tin from uniting with them: this indeed might be taken off by filing, but that being both too tedious and expensive, there is a way to it by steeping them in an acid water for a certain time, and scowering them with sand when taken out; by which method a woman can clean more plates in an hour, than an expeditious workman can file in several days. This water, which is kept a mighty secret, is nothing else but common water, made eager or sour with rye, which requires very little pains; for, after they have ground the grain grossly, and pounded it, they leave it to ferment in common water for a certain time, and with a little patience they are sure to have an eager menstruum: with this they fill troughs or tons, into which they put piles of iron plates, and to make it grow eager the better, and have more activity, they keep these vessels in vaults or stoves, which have a little air, and in which they keep lighted charcoal; the workmen go into these vaults once or twice a day to turn the plates, to take out such as are sufficiently cleansed, and put others in their room: and as the liquor is more acid, or the heat of the vault or stove more intense, the plates are sooner cleansed; but it requires at least two days, and sometimes a longer time. This is the method the Germans use for preparing the iron plates for tinning. In France they go another way to work; they dip the iron plates in acid menstruums, as in water wherein alum, common salt, or sal-ammoniac are separately dissolved. and instantly expose them to the air, in order to rust. After two days, during which every plate has been dipt into the menstruum twice or thrice, they are scowered.

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* See Page 220.

These menstruums, though weak in themselves, produce the effect as well as the stronger which are much dearer; among the latter, vinegar is the most effectual, especially if you dissolve a little sal-ammoniac therein, about a pound or two in a puncheon; by this means the iron rusts sooner than with any other salt, but it must be used very moderately, and the leaves be left to steep in clean water, to dissolve any particles of it that may stick to its surface, which may otherwise make it rust after it has been tinned.

In the preparation of the plates it must be observed, 1. In battering them, each parcel should receive the immediate action of the hammer in its turn, otherwise they will not extend equally. 2. Steep them in clay, or fuller's earth, tempered with water, before you heat them, to prevent their soldering with one another.

Whether you make use of the German or French way, in preparing your plates, it is absolutely necessary, after the plates are sufficiently scaled, to scower them with sand, and when there remain no more black spots on their surface, to throw them into fair water to prevent their rusting again, and to let them remain, till you are ready to tin them: the manner of doing it is thus; flux the tin in a large iron crucible, of the figure of a broken pyramid with four sides, of which two opposite ones are less than the two others; this crucible you heat from below; the upper rim you must lute quite round in the furnace: the crucible must be deeper than the plates are long, which you dip in downright, so as for the tin to swim over them. The tin being melted in the crucible, you cover it with a layer of a sort of suet, an inch or two thick, through which the plate must pass before it comes into the tin (the use of this is to keep the tin from burning): the common unprepared suet will render the success of the work uncertain: wherefore you prepare it by first frying and then burning it, which not only gives it a blackish colour, but puts it into a condition to give the iron a disposition to be tinned, which it does surprisingly.

The tin itself must have a certain degree of heat; for if it is not hot enough, it will not stick to the iron; if too hot, the coat will be too thin, of several colours, and a dirty yellow cast. To prevent this, you must make an essay with small pieces of the scaled plates, and see when the tin is in proper order. However, you dip the plates into tin that is more or less hot, according to the thickness you would have the coat; some plates you only give one layer, and these you plunge into tin that has a lesser degree of heat than that into which you plunge those which you would have take two layers: when you give these plates the second layer, you put them into tin that has not so great a degree of heat as that into which they were put the first time. Observe, that the tin which is to give the second coat, must be fresh covered with suet, but only with the *common sort*, without preparation: for, melted tin is sufficiently disposed to attach the new tin to be joined.

To gild upon Tin, Pewter, or Lead.

TAKE varnish of linseed oil; red lead, white lead, and turpentine; put them together into a clean pipkin, and let them boil; then grind them upon a stone, and when you gild pewter, take a pencil, draw the liquid thin upon what you would gild, and lay your leaf gold upon it; or instead of that, Augsburg metal; and press it with cotton to make it lie close.

Another Method to gild Pewter, or Lead.

TAKE the white of an egg, and beat it clear; with this wipe your tin or pewter, which must be first warmed

before

before a gentle fire, in such places as you design to gild; lay on your leaf gold quick, and press it down with cotton.

The juice of nettles is also fit for that use, and rather better than the clear of white of egg.

Another Method to gild Pewter.

TAKE leaves of staniol *, and grind them with common gold-size; with this wipe your pewter or lead over; lay on your leaf-gold, and press it with cotton: it is a fine gilding, and has a beautiful lustre.

A Method to gild with Pewter, or with Tin-foil.

THIS may be done several ways; but the best is to take white lead, ground with nut oil; with this lay your ground on what you design to gild, let it be wood or any thing else; then lay on your gilt tin leaves, press them down with cotton, or a fine rag, and let it dry; when dry, polish it with a horse's tooth or polisher, and it will look as if it had been gilded in fire.

To gild Lead.

TAKE two pounds of yellow ochre, half a pound of red lead, and one ounce of varnish, with which grind your ochre, but the red lead grind with oil; temper them both together; lay your ground with this upon lead, and, when it is almost dry, lay on your gold; let it be thoroughly dry before you polish it.

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* *Leaves of staniol* are not known by that name; but it is probable that *leaves of tin* are meant, *i. e. tin-foil*, because *stannum* is the Latin for tin (ignorantly called *staniol*); and this conjecture is corroborated by the following article. *Ed.*

SOME
EXPERIMENTS RELATING TO COPPER AND BRASS.

To make Brass.

THIS is done by mixing and melting copper and calamine, or zinc, together: calamine is dug in mines about Mendip, &c. in the West of England; it is burnt and calcined in a kiln made red-hot; then it is ground to a powder, and sifted to the fineness of flour, and mixed with ground charcoal, because the calamine is apt to be clammy, to clod, and not apt to incorporate; then they put seven pounds of calamine into a melting pot that holds about a gallon, and about five pounds of copper, uppermost; this is let down with tongs into a wind furnace, one foot deep, wherein it remains eleven hours, (one furnace holds eight pots;) after melting it, it is cast into lumps or plates. Zinc, reduced from its ore of calamine, may be immediately united to copper.

To melt Copper and Brass, and give it a quick fusion.

TAKE nitre, tartar and salt, and beat them together very fine. When you see that your metal begins to sink with the heat, fling a little of this powder into it, and, when melted, fling again a little into it, and when you observe it in fusion like water, fling a little again a third time: to twenty-five pounds of metal fling about a walnut size of powder, and your copper or brass will cast easily, and be of a malleable temper.

To make Brass that is brittle, and apt to crack in the Working, malleable.

TAKE tartar, nitre, and sulphur; pulverise them together:

ther; and after you have made your brass red-hot, strew it all over, and let it cool of itself.

A Solder for Brass.

TAKE one grain and a quarter of silver, three ounces of brass, one ounce of zinc, and melt them together; when melted, fling a good quantity of borax upon them.

To precipitate Copper from Aqua-fortis.

TAKE fine milled lead; cut it in little bits, and put it in the aqua-fortis which holds copper, and it will precipitate or sink it all to the bottom.

To make Copper as White as Silver.

PUT your copper into a strong melting-pot, in the midst of a quantity of glass, and set it in a glass furnace to melt; let the copper be covered all over with glass, and the glass will contract the greenness of the copper, and make it look white. If you repeat this several times, your copper will be the whiter. *Or,*

Take old copper that has been much used, or been long in open air or weather; melt it in a strong crucible before a smith's forge, or in a wind furnace, but take care of the smoke; let it melt a quarter of an hour, or longer, and clear it from the scales that swim at top: then pour it through a whisk, birch-broom, into a sharp lye, made either of quick-lime and vine-branch ashes, or salt of tartar, or such like, and the copper will corn fine and nice; then take it out of the lye, and let it melt again as before; repeat this four times running, in order to purify the copper, and when the copper is well purified, melt it over again; when it is in fusion, fling two ounces of crystalline arsenic in, by little and little; but avoid the smoke, and tie a handkerchief, moistened with milk, about your mouth and nose: after it has evaporated, or rather before it is done, fling into it two ounces of silver; and when that is melted, granulate it again through a whisk, and melt it again for use. It will be fit to make any thing in imitation of silver. *Or*,

Take white arsenic half a pound, nitre eight ounces, tartar eight ounces, borax four ounces, glass-gall four ounces; pulverize each very fine; then mix and put them together in a crucible, and let them flux in a wind furnace, for an hour or more; then pour them out, and you will have a whitish yellow substance.

Then take one part of old copper, and one part of old hammered brass, both cut into small pieces; neal these well, and quench them in lye made of a quart of urine, an handful of salt, four ounces of white powdered tartar, and two ounces of alum: boil them up together, and repeat it for ten or twelve times.

When thus you have cleansed the copper and brass, put them together into a crucible, and give them a strong fire, in a wind furnace, or before a smith's forge; let them flux well, and then fling of the above composition, which must be pulverized, one spatula after another into the crucible, stirring it sometimes about with a stick; (to one ounce of copper put an ounce and a half of powder): when all is thrown in and incorporated, fling a few pieces of broken crown-glass into it, and let it melt; then draw it out again with a pair of tongs, and fling sal-ammoniac into it, of the bigness of a walnut, and when it is thoroughly fused, pour it into a casting-pot, and your copper will be of a fine white.

If you take of this copper twenty-four ounces, and melt one ounce of silver amongst it, letting it flux well with sal-ammoniac, you will have a fine mass, which may be worked into what shape or utensil you please, and it will hardly be distinguished from silver plate.

When the silversmith works this composition, he must observe always in the melting, to fling some sal-ammoniac into it, to make it malleable; and in hammering, he must often neal it, and let it cool of itself; then hammer it gently, until it is as thin as he would have it; for if it is beat quick in the beginning, it will be apt to crack.

The more this metal is nealed and gently hammered, the better it will be. When the work is done, neal it; then, rubbing it with charcoal, and boiling it afterwards three times in a strong lye of tartar, your work will be like silver.

CHOICE SECRETS FOR BOOK-BINDERS.

To prepare a Lack Varnish for Book-binders, for French *Bindings.*

WHEN the book is covered, either with calf or sheep-skin, or with parchment, it is struck over with a varnish, and spotted with such colours as are taught under the article of "imitating tortoise-shell on ivory or horn:" some spot the leather before they lay on the varnish; and after they have sprinkled their colour, which they commonly make of umber, they lay the varnish over, and polish it with a steel polisher; after which they give it one layer of varnish more, which is the finishing stroke.

French *Leather for binding of Books.*

MAKE choice of such leather as is wrought smooth and fine; strain it on a frame; then, having your colours ready at hand, take first of one sort, in a pencil made of hog's bristles, and, with your finger, knock and sprinkle the colour thereof upon the leather; and when you have done with one, you may take another colour, and proceed with as many colours as you think proper: if you would imitate a tyger's skin, dot your colours upon the leather with a stick that is rough at the end, or with a pencil; and after it is well dried, lay it over with a *Spanish* varnish, which make in the following manner:

Take a pint of high rectified spirit of wine, of clear gum-sandarac four ounces, clear oil of spike one ounce; pound the sandarac, and put it into the spirit of wine, and then into the oil of spike; let it stand until it is dissolved and settled.

To make White Tables for Memorandum Books, to write upon with a Silver Bodkin or Wire.

Take of the finest plaster of Paris; temper it with hartshorn-glue, or any other glue; and having strained the parchment tight and smooth in a frame, wipe it over with the said mixture, on both sides; when dry, scrape it, to make it even; then cover it a second time with the same glue, and when dry, scrape and smooth it as before; this done, take ceruse, and grind it fine with linseed oil that has been boiled; and with a soft hair pencil lay it smooth and even on your parchment, or tables, and set it to dry in a shady place, for five or six days; when dry, wipe them over with a damp spunge, or linen rag, to smooth them, setting them to dry thoroughly until fit for use; then, with a sharp-edged knife, cut the tables to what size you please to have them, and bind them, fit for the pocket, with a little case for the silver bodkin, or wire, to write with.

To prepare Parchment that resembles Jasper or Marble.

Have a trough made in the manner directed under the article of "making marbled paper;" let it be filled with the warm solution of gum tragacanth, and having your colours ready prepared, as will be directed, stir the gum-water with a stick, and put it into a quick circular motion; in the interim, dip your pencil, with colour, in the center thereof, and the colour will disperse and form itself in rounds, as it is carried by the motion of the water; then stir it round in another place, and with a different colour proceed as you did with the first, until your trough is covered with variety of colours. When all is ready, and the water smooth and without motion, then lay on your parchment (which before has been laid between damp paper or cloths) and proceed therewith as you do with marbled paper; hang it up to dry, then smooth and glaze it in the manner you do coloured parchment.

A Green Transparent Parchment.

Wash the parchment in cold lye, until it comes clear from it; then squeeze out the liquor as much as possible: if you would have it of a fine green colour, take distilled verdigrise, ground with vinegar, and add a little sap-green to it; temper it neither too thick nor too thin: then soak your parchment in this colour, thoroughly, a whole night; rinse it afterwards in water; strain it immediately on a frame, and set it to dry; then take clear varnish, and lay it on both sides; set it in the sun to dry; after this cut the parchment out of the frame into leaves, as large as you please, and lay them in a book, under a press, to keep them fine and straight; the effect of this parchment is to make a small letter appear as big again; and it is a great preserver of the eyes, especially to those that read much by candle light.

The varnish must be prepared of linseed oil, and boiled with frankincense, mastich and sandarac.

If you would have the parchment of a clear, transparent, and white colour, only wash, strain, and varnish it as above*.

If you would colour it yellow, steep your parchment, after it has been washed, in a yellow liquid, made of saffron; for which purpose tie saffron in a thin linen rag, hang it in a weak lye, and let it warm over a slow fire; and when you see the lye tinctured yellow, it is fit for use.

For a Transparent Red.

TAKE Brasil-wood, as much as you will; put it into a hot lye, which is clear and not too strong, and it will tincture the lye of a fine red; then pour into it about half an egg-shell full of clear wine; draw the parchment through the colour, and when it is as deep as you would have it, strain it as before.

For a Blue.

TAKE indigo; grind it with vinegar, on a stone, and mix sal-ammoniac among it, to the quantity of a pea; with this wet your parchment, and proceed as has been directed for the green.

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* This clear and white transparent parchment, might suit for glazing *hot-houses*, and *cottages*, being less liable to break than glass. *Ed.*

For a Violet or Purple Colour.

TEMPER two-thirds of the above red, and one-third of the blue, and use it as before directed.

For a Black Colour.

TAKE alum, beat it into powder, and boil it in rain-water, to a fourth part; then add *Roman* vitriol, with some powdered nut-galls, and boil them together; with this stain your parchment twice or thrice over, and, when dry, lay the *Spanish* varnish over it.

With these transparent parchments you may make curious bindings. One sort used at *Rome*, is made thus; lay the boards, or paste-boards, over with leaf-gold, or leaf-silver, tin-foil, or metal leaves, &c. then binding the parchment over it, it will give it an uncommon lustre and beauty.

To gild the Edges of Books.

POUND bole-armenic and sugar-candy together, and mix with a proper quantity of the white of an egg well beaten; this done, take the book you intend to gild, which must be well bound, glued, cut, and well polished; screw it fast in the press, and as even as possible; then, with a hair pencil, give it a wipe with the white of an egg well beaten, and let it dry; then give it another wipe with the above composition, and, when dry, rub and polish it well: when you lay on the gold, wet the edges with a little fair water, and immediately lay on the gold leaves, cut of the due size, pressing them down softly with clean cotton wool; when dry, burnish it with a dog's tooth.

To

To make Red Brasil Ink.

You must first observe, that when you boil Brazil-wood for ink, you ought to do it when the weather is fair, or your ink will not be so good.

Take quick-lime, and pour rain-water on it, and let it stand over night. In the morning pour the clear water from the top, through a cloth: to a quart of this water take one pound of Brasil-wood shavings; let them boil half away, and put to it two ounces of cherry-gum, one ounce of gum-arabic, and one ounce of beaten alum; then take it, when all is dissolved, from the fire; pour it off the shavings, and put it up for use; you may also add to it a little clear chalk.

To prepare Brasil Ink without Fire.

Take a new glazed pipkin, in which put two handfuls of Brasil wood-shavings; pour half a pint of vinegar in, and let it stand over night; then put to it a piece of alum, as big as a walnut, with a little gum; take also chalk, scraped fine, about one handful; put it gently, by little and little, into the pipkin, and stir it well together with a stick, and it will begin to boil, as if it was upon the fire: you must set your pipkin in a clear earthen dish, before you put your chalk in; for as soon as the chalk is in, it will boil over: when this ebullition is over, put it again into the pipkin, and let it stand a day and a night, and you will have a fine Brasil ink.

To prepare Brasil Ink in Sticks.

Take Brasil-wood shavings, or chips; put them in a pan, and proceed in every respect as directed in the foregoing:

going: after the Brasil is thus made fit for writing, pour it into shells, and set it in the sun, where no dust can come to it, to stand a full hour: then take other shells, pour the top of the Brasil out of the first shells into them, and fling the settling away; set these shells also in the sun, and, after they have stood an hour, proceed as before; this do, till it is quite purified; then boil it to the consistence of wax, and put it up in a nut-shell, or in a piece of parchment; you may dilute it with wine or fair water, in a little cup, as much as you have occasion for, and write or paint with it; it is a fine colour, and very fit for colouring maps or prints.

By mixing the Brasil ink with a little ground indigo, you have a crimson or purple; and with a little white lead, you will have a rose colour.

To prepare or extract Lake-colours from Flowers.

Take flowers of a red colour; (if they stain white paper, when rubbed against it, they are good:) with these flowers fill a large head, upon a common cucurbit that is filled with spirits of wine; put a receiver to it, and lute it well; then distil over a gentle fire; the spirit will rise into the head, and the tincture will be extracted out of the flowers and herbs, and fall into the receiver. This coloured spirit, if distilled in another still, will pass without any colour, and may be used again for the like purposes; but the tincture, or colour, will remain at the bottom of the still, which take out and dry at a gentle heat: in this manner you may make good lake for painters.

To gild Paper.

Take yellow ochre, and grind it with rain-water, and lay a ground with it upon the paper, all over; when dry, take the white of eggs, beaten clear with white sugar-candy, and strike it all over; then lay on leaf gold, and, when dry, polish it with a tooth.

Some take saffron, and boil it in water, and dissolve a little gum with it; then they strike it over the paper, and lay on the gold, and, when dry, they polish it.

To make Indian Ink.

BURN lamp-black in a crucible, and keep it on the fire till it has done smoking: in like manner, burn some horse-chesnuts, till no vapour or smoke arises from them. Dissolve gum tragacanth to a proper consistence, and mix with it the lamp-black and chesnuts; stir them well together, and put the paste into moulds, or form it as you think proper, and the pieces let dry in the shade.

Another Method.

PUT five or six lighted wicks into an earthen dish of oil; hang an iron or tin concave cover over it, at a convenient distance, so as to receive all the smoke, when there is a sufficient quantity of soot settled to the cover, take it off gently with a feather, and mix it up in the manner above directed.

Note, That the best and clearest oil makes the finest soot, and consequently the best ink.

To perpare Blue Ink.

TAKE elder-berries, and press out the juice into a glass, and put powdered alum to it; add to it about its fourth part of vinegar, and a little urine; then dip a rag into it, and try whether the colour is to your liking: if it is too [illegible], add a little more of the juice; and if too dark, add more vinegar to it.

To make good Writing Ink.

IT must be observed, that according to the quantity of ink you design to make, the weight and measure of the ingredients must be either augmented or lessened: thus for instance, if you would have ten quarts of ink, you ought to take four quarts of water; six quarts of white-wine vinegar; three quarts of white wine; and proportion the rest, by weight, accordingly.

For a small Quantity of Writing-Ink.

TAKE one pint of water, one pint and a half of wine, one pint and a half of white-wine vinegar, and mix all together; then take six ounces of galls, powder'd and sifted through a fine hair sieve; put them into a pot, or bottle, by themselves, and pour on them one half of your mixed liquor; take also four ounces of powdered vitriol, and put it into a bottle by itself, and pour half the remaining liquid upon it: to the rest of the liquor put four ounces of gum arabic, beaten fine: cover these three pans, pots, or bottles, and let them stand three days, stirring every one of them three or four times a day; on the fourth day, put the pan with the galls upon the fire, and, when you see that it is almost ready to boil, keep the galls down, and, whilst it is warm, pour it into another vessel, through a cloth; do not squeeze or wring the cloth, but let it run through of itself; then add the liquor which is in the two other vessels to it, stir it well together; let it stand three days, stirring it every now and then; the fourth day, after it is settled, pour it through a cloth into a jar, or bottle, and you will have good writing-ink.

Ink for Parchment

Is prepared in the same manner as the foregoing, only, to a pint of water, take but half a pint of wine and half a pint of vinegar, which together will make one quart of ink. *Or,*

Take three or four ounces of powdered galls, and three or four ounces of gum arabic; put them together into a vessel, with rain water, and when the gum is dissolved, then strain through a cloth, and add nearly half an ounce of powdered vitriol. *Or,*

Take one pint of beer, and put in it one ounce of powdered gall; let it boil till you see it of a reddish colour: then add to it six drams of green vitriol, powdered, and let it boil again: when you take it off the fire, add six drams of gum-arabic, and of alum the bigness of a pea, both powdered; stir it till it is cold.

Another Receipt for Writing-Ink.

TAKE, five ounces of galls, six ounces of vitriol, four ounces of gum, a little powder of walnuts, two gallons of beer; put them into an earthen pot, and add a little sal-ammoniac, to keep the mixture from moulding. *Or,*

Take for one quart of ink, one pint, and half a quartern, of water, half a quartern of wine, half a quartern of good vinegar, four ounces of vitriol, and four ounces of galls, (both powdered by themselves); then mix them together in a glazed vessel, and pour the aforesaid liquor upon it; stir it often, during six days or more; and, when settled, pour it into a bottle, and you will have very good ink.

To make Ink Powder.

TAKE peach or apricot stones, sweet or bitter almonds: burn them to a black coal in an iron ladle, or fire shovel: take likewise resin, and put it in a ladle, and make it flame and burn, catching the smoke in a little skillet, or a linen canopy put over it; after the resin has done burning, wipe the smoke on a white paper, and put it up for use; but, to save the trouble, you may use lamp-black; take of the said smoke, or lamp-black, one part; of the coals burnt of the stones, one part, of vitriol, one part; powder of galls, which first you fry a little in a ladle with a little oil, two parts, gum-arabic four parts: let all be well mixed and pounded together, and then keep this powder in a leather bag for use, the older it is the better it will be: when you have occasion to use it, temper a little of it with wine vinegar, or water, made hot, (if you can have it conveniently), if not, you may make shift with cold. This powder put into pale ink will immediately make it black, and of a fine gloss.

To prepare Red Ink.

TAKE two ounces of fine Brasil chips, the whites of twelve eggs, and the quantity of a hazel-nut of alum; beat the whites of the clear eggs, put them all together in the sun, or before the fire; stir them sometimes about; strain them through a cloth, and let the juice dry well, then keep it from dust, and when you would use it, only temper it with fair water. *Or,*

Take the best Brasil-wood, in chips, put it into a cup or pot that is glazed; pour good wine vinegar over it, and let it stand three or four hours to soak; then take beer that is clear and bright, and mix it with clear pump-water, about an inch above the chips; set it on a gentle fire; let it boil, and take care it does not boil over; after it has boiled some time, add powdered alum, the quantity of a walnut, to it, and as much gum arabic; set it again upon the fire, and let it boil; after it has boiled a little, take it off, and strain the liquor from the chips; put it into a glass, and close it up, and you will have a fine red-ink.

If, instead of alum, you put a little sal-ammoniac to it, it will make the ink look bright.

Yellow Ink.

TAKE the yellow cowslip flowers, which grow common in the fields; squeeze out the juice, and mix it with alum:

Saffron-water with a little alum, makes likewise a good yellow.

To make Letters, or other Characters, of a Gold or Silver Colour.

TAKE flint glass, or crystal; grind it to powder; temper it with the white of an egg, and write with it; when it is dry, take a gold ring, or a silver thimble, or any piece of either of those metals, and rub your writing therewith gently over; and when you see the gold or silver strong enough, glaze it over with a tooth.

To make Letters of Gold or Silver embossed.

TAKE the juice of garlic, and mix it with writing-ink, or, rather, with a red or yellow colour, for gold. Write therewith your letters or ornaments on vellum or paper; when dry, repeat going over them again, so as to give them a body; then let it dry: when you lay the gold leaves on, warm the letters with your breath, and close the gold with cotton upon them; it will have a good effect.

A rare Secret to prepare Gold the ancient Way, to paint or write with.

TAKE leaves of gold, and put them in a clean pipkin on the fire, so as to heat; in another pipkin put quicksilver (four times the quantity, in weight, of the gold) near the fire to warm it; this done, take both pipkins from the fire; pour the quicksilver upon the gold leaves, and immediately stir it together with a little stick; put it into a dish full of fair water; and you will have an amalgam, which you may work with strong vinegar, or the juice of lemons, on a flat stone, to incorporate it the more; then you knead and wash it well with fair water, and strain it through a lamb's skin, to bring out the quicksilver; then take what remains in the skin, and put to it half as much powdered brimstone; mingle it with the said paste, and set it on the fire, in an iron ladle, or a crucible, leaving it till the brimstone is burned, and all the rest is of a yellow colour; then let it cool, putting it into a dish, and washing it with fair water, till you have a fair colour of gold; then put it up in a glass phial, and when you have occasion to use it, dilute it with a little rose-water mixed with a little gum arabic: you may paint or write with it as you please; and when dry, you may burnish it with a dog's tooth, and it will be of a fine lustre.

To write Golden Letters with a Pen.

TAKE sixteen leaves of the finest gold; put it upon a colour-stone; sprinkle a little vinegar over it, and let it lie for a little while; then grind it with your muller to a fine powder; put this into a muscle-shell, with as much clear water as will fill it, and mix it together with your finger;

then let it settle, and, after that, pour off the water, and supply it with clear water again, stirring it well with your finger, as before; repeat this till you see the water come off from the gold as clear as when put on; after you have thus cleared your gold, temper as much as you have occasion for with a little clean gum water, till you see it will easily flow from your pen; after your writing is dry, glaze it gently with a tooth.

Fine Red Ink of Vermilion.

TAKE vermilion, and grind it fine with clean water, and put it up to keep from dust; when you would use it, take as much as you think you shall have occasion for, and dilute it with a little gum water. *Or,*

Take half an ounce of vermilion, or prepared cinnabar, and put it into a gallipot; take a little powdered clear gum arabic, and dissolve it in water, and temper with your vermilion: you may add a little of the white of an egg to it, beat up till all becomes clear.

An artificial Water for writing Letters of Secrecy.

TAKE vitriol, finely powdered, and pour clean water on it; after it has stood a little, write therewith either on vellum or paper, and the writing cannot be seen any other way than by drawing the letter through a water, which is thus prepared: take a pint of water, and put it into one ounce of powdered galls; temper it together, and strain it through a cloth; put the liquor into a dish that is wide enough, and draw your writing through it, and you will read it as you do other writings: to make the secret contents less liable to suspicion, you may write, on the contrary side of the paper, or parchment, with black writing ink, matters of less consequence.

Another Secret, to write a Letter, white upon white, which cannot be read but in fair Water.

TAKE alum, beat to a fine powder: mix it with water, so as not to be too thin; then take a new pen, and with this mixture write what you please upon paper, and let it dry: then let him, who is to read it, lay the letter into a flat bason, or dish, that is filled with clean water, and in a quarter of an hour the letters will appear white upon white, so that they may be plainly seen and read. *Or,*

Take the juice of onions, and write with it; he who would read it, must hold it over the fire, and the writing will turn of a reddish or brownish colour.

The Manner of marbling Paper or Books.

TAKE clear gum tragacanth, and put it into an earthen pan; pour fresh water to it, till it is two hands high over the gum; cover it, and let it soak twenty-four hours; then stir it well together, and add more water to it; keep it often stirring during the day, and it will swell; when you find it well dissolved, pour it through a cullendar into another pan; and add to it more water after it has stood a little, and been stirred about, strain it through a clean cloth into another clean pan; keep it well covered, to hinder the dust or any other thing from coming to it: this water, when you go to make use of it in marbling your paper or books, must be neither too thick nor too thin; you may try it with your comb, by drawing the same from one end of the trough to the other; if it swells the water before it, it is a sign that it is too thick, and you must add, in proportion, a little more water.

Your trough must be of the largeness, and the shape of your paper, or rather something wider, cut in flag-stone, about four inches deep.

After you have filled your trough with the aforementioned water, and fitted every thing for the work, (before you lay on your colours) take a clean sheet of paper, and draw the surface off, by dipping it flat, which will be a thin sort of film; then have your three colours, namely, indigo mixt with white lead, yellow ochre, and rose pink, ready prepared at hand; and, for each colour, have two gallipots, in order to temper them as you would have them, in different shades.

All your colours must be ground very fine with brandy.

The blue is easily made deeper or lighter, by adding more or less white lead.

The yellow used for this purpose, is either yellow orpiment, or *Dutch* pink.

For blue, grind indigo and white lead, each by itself, in order to mix the colour either lighter or darker.

For green, take the aforesaid blue and white, add some yellow to it, and temper it darker or lighter, as you would have it.

For red, take either lake, or rose pink, or, rather, ball-lake.

Every one of these colours are to be first ground very fine with brandy, or spirits, and, when you are ready to go to work, add a little ox or fish-gall to them; but this must be done with discretion: you may try them, by sprinkling a few drops upon your gum water; if you find the colour fly and spread too much about, it is a sign of too much gall; to remedy which, add more of the same colour, which has no gall, and when you see the colour retract itself again gently, it is right.

When thus you have your colours, and all things in good order, take a pencil, or the end of a feather, and sprinkle on your red colour; then the blue, yellow, green, &c. Begin your red from No. 1, and go along your trough to No. 2; also the blue from No. 3, all along to No. 4;—the yellow and green put here and there in the vacant places; then with a bodkin, or small skewer, draw a sort of a serpentine figure through the colours, beginning from No. 1, to No. 2: when this is done, then take a comb, and draw the same straight along from No. 1, to No. 2: If you would have some turnings, or snail-work on your paper, then, with a bodkin, give the colours what turns you please.

Now you are ready to lay on your paper, which must be moistened the day before, in the same manner as printers do their paper for printing: take a sheet at a time, and lay it gently upon the surface of your colours in the trough, and press it slightly with your finger in such places where you find the paper lies hollow; this done, take hold of one end of the paper, and draw it up at the other end of the trough; hang it up to dry on a cord; when dry, glaze it *, and it is done. You may also embellish your paper with streaks of gold, by applying muscle-shell gold or silver, tempered with gum-water, among the rest of the colours.

To silver Paper, after the Chinese *Manner, without Silver.*

TAKE two scruples of clear glue, made of strips of leather boiled; one scruple of white alum; half a pint of clean water; simmer it over a slow fire; then, your sheets of paper being laid on a smooth table, you dip a pretty large pencil into the glue, and daub it over as even as you

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[*] The glazing of this paper is performed with a polished flint, fastened at the bottom of a pole, fixed vertically through a hole in a transverse beam, and rubbed briskly over the paper.

can; repeat this two or three times; then sift the powder of talk through a fine sieve, made of lawn, over it, and hang it up to dry, when dry rub off the superfluous talk, which serves again for the same purpose. The talk you are to prepare in the following manner:

Take fine white transparent talk, which comes from Muscovy, and boil it in clear water for four hours; then take it off the fire, and let it stand so for two days; take it out, wash it well, and put it into a linen rag, and beat it to pieces with a mallet: to ten pounds of talk add three pounds of white alum, and grind it together in a little hand-mill; then sift it through a lawn sieve, and, being thus reduced to powder, put it into water, and just boil it up. Then let it sink to the bottom; pour off the water from it; place the powder in the sun to dry; and it will become a hard substance. Beat this in a mortar to an impalpable powder, and keep it for the use above-mentioned, free from dust.

To prepare Ink, so that what is written therewith cannot be read but in a Dark Place.

TAKE half a pint of goat's milk; a sweet apple, peeled and cut; and a handful of touchwood, which in the night-time seems to shine; put these into a mortar, and beat them together, pouring now and then a little of the goat's milk to it; after this is well beaten, pour the rest of the milk to it, and stir it well together; then wring it through a cloth: with this liquor, write what you please, and, if you would read it, go into a dark cellar or chamber, and the writing will appear of a fiery or gold colour.

To make fine Red Paper.

TAKE a pan full of water; put some quick-lime into it, to make it into a lye, and let it stand over night; then put Brasil chips into a clean pot, about half full, and fill it with the lye, and boil it to half; when it is just hot, add to it a little alum: when you use it, mix it with a little gum, or size, and with a pretty large hair-pencil lay your colour on the paper, with an even hand.

To prepare Ink, for drawing of Lines to write upon evenly, which may be rubbed out again.

BURN tartar to ashes, or until it is calcined, to a white colour; take thereof the bigness of a hazel-nut, and lay it into a cupful of water to dissolve; then filter it: to this solution mix as much fine ground touch-stone as will colour it black enough to write with; with this ink rule the lines you would write upon: when you have done writing, only rub it over with the crumb of a stale roll, or with a crumb of bread, and the lines will vanish from the paper. This may be useful at schools.

To write so that the Letters may appear White, and the Ground of the Parchment Black.

TAKE clean water, and temper it with the yolk of an egg so as to be fit for writing; with this, write upon your vellum, or parchment, what you please; let it dry, and draw it through ink, so that it may take every where; or strike it over with a large soft pencil, to make it of a good black; when it is thoroughly dry, scrape it gently off with a knife, and the writing will appear as white as the parchment was before you wrote upon it.

To make Oil Paper.

TAKE the shreds of parchment; boil them in clear water until it is clammy, and like a strong glue; strain it through a cloth, and with a large pencil strike it over the paper; when dry, varnish it over with a varnish of turpentine, or Spanish varnish.

CHOICE
SECRETS FOR CABINET MAKERS, AND TURNERS.

To prepare a Black Colour for staining Wood.

PUT two ounces of iron filings into a new earthen pan; add to it one ounce of sal-ammoniac, dissolved in a quart of vinegar, and let it stand twelve days (the longer it stands the better it will be;) then take rasped logwood, and three ounces of gall-nuts, pounded fine; infuse this in a quart of lye made of lime; let this also stand the same time as the above.

When you have occasion to use it, warm both those liquors over a slow fire, and with the lye first strike the wood over you design to dye, and then with vinegar; repeat this until you see the wood black enough to your liking; after which, wax the wood over with bees-wax, and rub it with a woollen rag, and it will look bright and fine.

To imitate Ebony Wood.

TAKE clean and smooth box, and boil it in oil until it turns black. *Or,*

Take smooth-planed pear-tree wood, strike it over with aqua-fortis, and let it dry in a shady place in the air; then wipe it over with good black writing-ink, and let it also dry in the shade; repeat and wipe the ink over it until the black is to your liking. Then polish it with wax, and a woollen rag.

Another,

Another, but more costly, Method.

DISSOLVE one ounce of fine silver in one pound of aqua-fortis; add a quarter of a pint of clear water to it; with this strike your wood over, repeat it until you perceive it to be as black as velvet, then polish it with wax.

Another Method.

TAKE what sort of wood you please, box, cedar, mulberry, pear-tree, or the like; steep it for three days in alum-water, in a warm place; or, if it be in the summer, in the sun; then boil it in oil, in which mix some vitriol and sulphur; the longer you boil it the blacker the wood will be; however, you must not let it boil too long, lest it should be scorched. *Or,*

Strike your wood over with spirits of vitriol, and hold it over a coal fire; repeat this until it is black enough; then polish it. *Or,*

Iron filings, steeped in beer and wine, will make a good black. *Or,*

Put one pound of rasped Brasil into a clean pan; boil it in three pints of strong white-wine vinegar until the half is boiled away; then pour it clear off; take also one pound of bruised gall-nuts, and put them into another pan with water, and let them stand for eight days in the sun to soak; then put to it eight ounces of vitriol, and stir it together, and let it stand for two or three days; pour it off clear, and add to this liquor the fourth part of the prepared Brasil; with this strike your wood over twenty or thirty times running; letting it every time dry in the shade.

Then take fine silver, as much as you please; dissolve it in common aqua-fortis, add to it twice the quantity of spring-water; with this strike over the dyed wood, once or twice; set it in the air to dry, and it will be of a fine coal black; after which, polish it, as before directed.

An excellent Secret to Dye Wood of any Colour.

PUT fresh horse-dung, the moistest you can get, upon some little sticks laid across one another, over an earthen pan, to receive the liquor that drops from the dung; supply it with fresh dung every time it is drained until you have a sufficient quantity. Then divide the liquor into as many pots as you intend of colours, and put into each pot the bigness of a horse-bean of alum, and as much gum-arabic; then steep what colour you will in the liquor, and put in the pieces of wood, which, after it is stained to your liking, take out and dry; the longer you let it remain in the liquor, the deeper will be the colour; by this means you may shade your wood from a deep to a light colour, which will penetrate so as never to fade or vanish.

To Dye Wood of a Red Colour.

TAKE one handful of quick-lime, and two handfuls of wood ashes; put them together into rain-water, and let them soak for half an hour, until they are well settled, and you have a good lye. Then take a new pan, in which put one pound of Brasil-wood; pour on it the said lye, and, after it has soaked for half an hour, let it boil; when it is cold, pour it off into another clean pan, and fling one ounce of gum-arabic into it; take another earthen pan with rain-water, and put into it two ounces of alum; boil your wood in it, and after it is well soaked, take it out, and let it cool a little, warming, in the mean while, the red colour, and striking it over your wood; repeat this until your colour is deep enough to your liking; then polish it with a dog's tooth.

Another Red for dying Wood.

TAKE rasped Brasil-wood, and boil it until you see it of a fine red colour; then strain it through a linen cloth.

The wood you design to dye, colour first over with saffron yellow, and after it is dry, strike it over with the red colour, until it is deep enough; then polish it with a tooth. If you put a little alum to the Brasil colour, it will turn to a brown.

To Etch Figures upon Wood.

TAKE melted tallow, and, having your table or board of wood ready, form with it flowers, or what else you will, upon it; then, with a coloured water, boiled with vitriol, nitre and alum, cover the board, over the tallow; let it stand, or repeat it, until the colour pleases you. In this manner, you may marble, or cloud, your wood, as pleases you.

To Marble upon Wood.

TAKE the whites of eggs, and beat them up until you can write or draw therewith; then with a pencil, or feather, draw what veins you please upon the wood; after it is dried and hardened for two hours, take quick-lime, and mix it well together with wine; and with a brush, or pencil, paint the wood all over; after it is thoroughly dry, rub it with a scrubbing-brush, so that both the lime and the whites of the eggs may come off together; then rub it with a linen rag, until it is smooth and fine; after which, you may lay over a thin varnish, and you will have a fine marble wood. *Or,*

Grind white-lead, or chalk, together with water, upon a marble very fine; then mix it up with the whites of well-beaten eggs, wherewith paint, or marble, as you think proper; when dry, strike it over with a lye made of lime and urine, and this will give the wood a brown-red colour: upon this colour you may, when dry, marble again with the whites of eggs; and again, when dry, give it another brush with the lye: after you have, with a scrubbing-brush, rubbed off the marbling with whites of eggs, you may strike once more all over with the lye; and your work, when dry and polished, will look very agreeable, and of a fine marbling.

A Gold, Silver, or Copper-colour, on Wood.

TAKE crystal, and beat it in a mortar to powder; then grind it on a marble, with clean water, and put it into a clean new pot; warm it, and add to it a little glue; with this strike, or paint over, your wood: when dry, take a piece of gold, silver, or copper, and rub it over therewith, and you will have the colour of any one of those metals upon the wood, which you may afterwards polish.

To colour Wood of a Walnut-tree Colour.

TAKE the bark of walnut-trees, or the green shells of walnuts; dry them in the sun, and mix as much as you have occasion for with nut oil; boil it up, and rub the wood over with it.

To stain Wood of a fine Green.

TAKE green nut-shells, and put them into a lye made of Roman vitriol and alum, in which let them boil an hour or two. To this lye add some verdigrise, finely ground with vinegar; then take your wood, after you have soaked it for two days in strong white-wine vinegar, and boil it therein. *Or,* Take the finest verdigrise, and grind it with sharp wine vinegar; add to it a little tartar; let it stand over night, and the verdigrise will settle, and you will have a fine green; with this strike over your wood, several times: if you would have it of a grass green, put a little sap-green amongst it.

A Red Colour, for Wood.

TAKE quick-lime, and pour rain-water upon it: let it stand over night, and filter it through a cloth; then add more rain-water to it, and put in clear and fresh Brasil chips, together with the wood you intend to dye, and boil till the colour is to your liking. The wood is first to be thoroughly soaked in alum water. *Or,*

Polish your wood-work, after you have finished it with your plane, and then lay on it muscle-shell gold or silver, diluted with size, or with the white of an egg; marbling it in the manner before directed in marbling of wood; when dry, strike it over, several times, with the following colour:

Take rasped Brasil, and pour on it oil of tartar, or infuse it therein, and it will extract a fine red colour: this coloured oil pour off, and put fresh oil to the Brasil, to extract more of the colour. Let these extractions dry gently; then draw it off again in spirits of wine, and you will have a red for your use.

A Violet Colour for Wood.

TAKE four ounces of Brasil, and one ounce of indigo; infuse them together in a quart of water, and boil your wood therein.

To adorn Wood with Ornaments of Silver or Tin.

FIRST carve, or hollow, your ornaments out upon your wood, in the best manner, so as to undermine the edges on both sides of your strokes. Then make an amalgam of tin, by dissolving it over a gentle heat, and putting into it the same quantity of quicksilver, which you have heated; stir with a stick well together, and pour it into a pan of cold water; when dry, grind it upon a marble, with water, very fine, tempering it with clear size; then fill up the carved figures, smoothing it with your hand; and, when dry, polish it. To make it more of a silver colour, rub it over with an amalgam of silver-leaf and quicksilver, and polish it with a dog's tooth.

Instead of tin, you may use bismuth ground fine with water.

To Emboss, or trace all Manner of Ornaments on a gilded smooth Pannel, the Gold being laid over with Black, or any other Colour.

FIRST gild your pannel, or other wood work, as you are directed under the article of gilding, and when thoroughly dry, paint it all over smooth and even with lamp-black, ground with linseed and nut-oil; add to it an equal quantity of umber, in order to dry it the better; after you have set it for two or three days, or more according to the time of the year, to dry, then, before it is quite hard, draw or pounce what you design to emboss, and with a blunt-pointed bodkin, horn, or wood, trace into the black lay, down to the gold, opening the traces, and making the gold appear in the best manner you can. In birds, plants, cattle, and such like, you must observe to take the heightenings clear out, and leave the shade, by hatching into the black, agreeable to your design; the fine and soft shades of the hair, &c. you may finish with a fine pencil, with the black colour, upon the gold; and when you have done, let it dry thoroughly for three or four days more; then lay over it a clear varnish, which you may, after it is dried, repeat a second time, and your work will look beautiful.

To do this upon a Blue Ground.

After you have gilded your work, then take alum which is not too coarse, mix it with mortar on a marble-stone, adding to it the white of an egg: with this and a little water mix your smalt, and strike it fine and even over the gilding: then, when it is almost dry, sift through a fine sieve some of the finest smalt over it: you may, if you will, mix it with spangles of several colours; and when thoroughly dry, wipe off what sticks not to it, and proceed in tracing up your figures you design for gold. The fine finishing strokes upon the gold, because they cannot well be done with smalt, may be done with Prussian blue or indigo mixed with white lead. You may, if you will, varnish it; but it will look better without.

VARIETIES OF
GLUES AND CEMENTS, FOR JOINING WOOD, STONE, GLASS AND METALS.

An excellent Glue for Wood, Stone, Glass, and Metals.

Take good glue four ounces, soak it over night in distilled vinegar, then boil it up therewith; take a clove of garlic, beat or bray it in a mortar, and add to it one ounce of ox-gall. Wring this juice through a linen-cloth into the warm glue; then take mastich and sarcocolla, of each one drachm, sandarac and turpentine of each two drachms: grind the sandarac and mastich fine, and put them together with the sarcocolla and turpentine into a phial; pour one ounce of the strongest brandy upon it, and let it stand three hours in a moderate heat, well stopped up, giving it now and then a shake; add this also to the warm glue; then stir or beat it together with a wooden spatula, till some of the moisture is evaporated, and the glue is grown cold. When you have occasion to use it, then take as much or as little as your work requires, soak it in strong vinegar, till it is dissolved. If you use this glue for stones, mix it with tripoli, or with some powdered chalk; and if for glass, mix, besides a little tripoli, fine ground Venice glass; and if you would use it for metals, as iron, brass, copper, put to it some of the finest filings; you may also add a little isinglass. And if you would have this glue hold out or stand the water, mix it up with a strong varnish, as much as the present occasion requires.

A good Stone Glue, or Cement for Grotto-work.

Take two parts of white resin, melt it clear, add to it four parts of bees-wax; when melted together, add stone flour, made of the stone you design to cement, two or three parts, or so much as will give the cement the colour of the stone; to this add one part of flour of sulphur. First incorporate all together over a gentle fire, and afterwards knead it with your hands in warm water. With this cement the stones, after they are well dried, and have been warmed before the fire, in order to receive the cement the better.

A Wood Glue, which stands Water.

Common melted glue, mixed up with linseed oil or varnish, applied to the places to be glued together, after

they

they have been warmed, when thoroughly dry, will last and stand water.

Another fine Glue.

TAKE isinglass and common glue, soak them over night in strong brandy; then dissolve them over a coal fire, and mix with a little fine powdered chalk: this will make a very strong glue.

Another extraordinary Glue.

TAKE sal-ammoniac, sandarac and gum-lac; soak and dissolve them in strong brandy, over a gentle heat, and put to them a little turpentine; when all is dissolved, pour the solution over isinglass and common glue, and in a close vessel, dissolve it over a slow fire; add to it a little glass-dust, and when it is of a right temper, use it.

A good Water-cement.

TAKE one part of minium or red lead, and two parts of lime; mix them well together with the whites of eggs.

Stone-glue, wherewith you may glue either Stone or Glass.

TAKE white flint-stone in powder, dry and finely sifted; then take white resin, and melt it in an iron or earthen ladle, and stir the powder in it, till it is like a thick paste: warm the glass, or what you design to glue together; gild the places or joinings, and it will add a great beauty. This has been made use of in the embellishment of cabinets, and other things.

An exceeding fine Cement to mend broken China, or Glasses.

GARLICK stamped in a stone mortar, and the juice applied to the pieces to be joined together, is the finest and strongest cement for that purpose; and will leave little or no mark, if done with care.

A Cement for broken Glasses.

BEAT the white of an egg very clear, and mix with it powdered quick-lime; with this join your broken glasses, china, and earthen ware. *Or*,

Take isinglass, powdered chalk, and a little lime; mix them together, and dissolve in fair water over a slow fire; with which cement your broken glass, or china ware, and set it to dry in the shade. *Or*,

Take isinglass, mastich and turpentine; dissolve them, and cement your broken ware; when dry, they will hold, and rather break in another place, than where joined and cemented. *Or*,

Take quick-lime, and mix it with old cheese which has been boiled in water to a paste, with this cement your glass, or china, and it will answer your desire. This paste is likewise a good *lute*, to lute a cover to an earthen pan, or glass, retorts, &c. You may add a little fine brick-dust to it.

A Lute or Cement, for Cracks in Glasses used for Chemical Preparations, which will stand the Fire.

TAKE wheat-flour, finely powdered Venice glass, or Florence flask, pulverized chalk, of each an equal quantity; fine brick-dust one half of the quantity, and a little scraped flint; mix it up with the white of an egg, smear it on a linen cloth like a plaister, and with it enclose the cracks of your glass retort, or other glass utensil; but let it dry before you put it to the fire. *Or,*

Take old varnish, and glue your pieces together; tie them close, and set them to dry in the sun, or a warm place; when dry, scrape off the varnish that is pressed out at the sides, and it will hold very well.

To join broken Amber.

ANOINT the pieces with linseed oil, join and hold them close together over the fire.

An excellent Glue or Cement to mix with Stone, Glass, Marble, &c. in order to make Utensils, Images, and other things therewith.

TAKE of fine glue four ounces; of mastich two ounces; of powdered sealing-wax six ounces; of finely ground brick-dust one ounce; put the fish glue into a glazed pipkin, with water, upon a slow fire; and after you have mixed your ingredients, put it into the pipkin, and boil it up; and what hangs together, use; if you mix it up with finely powdered glass, of any colour, you may form it to what shape you will; and when cold and dry, it will be as hard as stone.

Another Cement, which dries quickly.

TAKE pitch, as much as you will; melt it, and mix it with brick-dust and litharge; and, to make it harder, moisten the brick-dust first with sharp vinegar and a larger quantity of the litharge, and it will be as hard as stone.

Good Glue-sticks; or Spittle-glue, fit for Bookbinders.

TAKE two ounces of isinglass, half an ounce of sugar-candy, and half a drachm of gum tragacanth: then take half an ounce of slips, or parings, of white parchment, pour on it a pint of water, and let it boil well; take that water, strain it through a cloth, and pour it over the two other ingredients, mixed with a little rose water; let it boil away above half, then take it off the fire, and cast it into little flat sticks; or in any shape you please.

A Water-cement, which grows the harder for being in Water.

TAKE mastich, frankincense, resin, and finely cut cotton, of each an equal quantity; melt, and, with some powdered quick-lime, mix them up into a mass.

A Cement as hard as Iron.

MELT pitch, then take powdered sand, worn off from grind-stones; stir them well together; boil up, and it is fit for use.

SEVERAL CURIOUS

SECRETS RELATING TO IVORY, BONE, AND HORN.

To whiten Ivory that is become Red or Yellow.

BOIL alum in fair water, so much as will make it look white; into this put your ivory for an hour, to soak; rub it with a hair cloth, and wipe it over with a clean napkin, or linen rag, moistened; in this let it lie, till it dries gradually, else it will be apt to split.

Another Method to whiten Green Ivory.

Boil the ivory in water and quick-lime, till you see it has a good white.

To imitate Marble upon Ivory.

Melt bees-wax and tallow together, or else yellow and white bees-wax, and lay it over your ivory; then with an ivory bodkin, open the strokes that are to imitate marble; pour the solution of some metal or other on them, and let it stand a little while; then pour it off, and when it is dry, cover those strokes again with wax, and open some other veins with your bodkin for another metallic solution; and this repeat to the number of colours you design to give it.

N. B. The solution of gold gives it a purple; of copper, a green; of silver, a lead-black; of iron, a yellow and brown colour. These solutions well managed, and applied on ivory, will intirely answer the design of the artist.

By this method you may imitate tortoise-shell, and several other things, on ivory.

To stain Ivory of a fine Green.

Take two parts of verdigrise and one part of sal-ammoniac; grind them well together, pour strong white-wine vinegar on them, and put your ivory in; let it lie covered, till the colour has penetrated, and is deep enough to your likeing. If you would have it marbled or spotted, sprinkle or marble it with wax.

And thus you may colour your ivory with any other colours, if you prepare them in the manner directed, viz. with sal-ammoniac and vinegar.

To dye Ivory, or Bone, of a fine Coral Red.

MAKE a lye of wood-ashes, of which take two quarts; pour it in a pan upon one pound of Brasil wood; to this add one pound of alum, and two pounds of copper filings, and boil it for half an hour; then take it off, and let it stand: in this put the ivory, or bone; and the longer it continues in this liquor, the redder it will be.

To stain Ivory, or Bone, of a Black Colour.

TAKE of litharge and quick-lime, an equal quantity; put them into rain-water over the fire, till it begins to boil. In this put the bone or ivory, stirring them well about with a stick; and afterwards, when you see the bone receive the colour, take the pan from the fire, stirring the bone all the while, till the liquor is cold.

To dye Bones of a Green Colour.

TAKE a panful of clean water, and put into it a pretty large piece of quick-lime, leaving it so for twenty-four hours; pour it off clear; the bones you intend to dye boil in common water, wherein alum has been dissolved for some time; then scrape them well, and put them into the lime-water, mixt with verdigrise; boil them well, and then take them out to dry: instead of lime-water, you may make use of urine, which will answer the same purpose.

To dye Bones, or Ivory, the Colour of an Emerald.

PUT copper-filings into some aqua-fortis; and when it has done working, put in your wrought bone or ivory, leaving it therein for twenty-four hours; then take it out, and it will be of a pleasant emerald-colour.

To dye Bones, Red, Blue, or any other Colour.

FIRST boil the bones in alum water; then take quick-lime-water, or urine; put into it, Brasil wood, lackwood, or madder, or whatever colour you please; then boil the bones, or ivory, therein, and it will answer your purpose.

To make Horn soft.

TAKE urine, which has been put by and covered for a month; in this boil one pound of wood-ashes, or the ashes of vine-stalks, two pounds of quick-lime, eight ounces of tartar, and eight ounces of salt; after it is boiled, pour it through a flannel, and filter it thus three times. Keep this lye covered, and soak the horn therein for eight days, and it will be soft.

Another.

TAKE wood-ashes and quick-lime; of this make a strong lye, filter it clear, and boil the shavings or chips of horn therein, and they will be like a paste; you may colour it of any colour, and cast or form it into any thing you please.

To prepare Horn Leaves in Imitation of Tortoise-shell.

TAKE of quick-lime one pound, and litharge of silver eight ounces; mix with some urine into a paste, and make spots with it, in what form or shape you please. on both sides of the horn; when dry, rub off the powder, and repeat this as many times as you will. Then take vermilion, which is prepared with size, lay it all over one side of the horn, as also on the wood, to which you design to fasten it.

For raised work, form the horn in a mould of what shape soever: put it by to dry, and with the aforesaid paste and the vermilion give it the colour; then lay on a clear glue (neither too thick, nor too thin) both upon the horn and the wood on which it is to be fixed, and close it together; do this work in a warm place, and let it stand all night; then cut, or file off, the roughness, or what is superfluous about it; rub it over with a coal, and polish it with tripoli and linseed oil.

The work made in this manner looks very beautiful and natural; and may be used, by cabinet-makers, for pillars, pilasters, pannels, or any other embellishment in cabinet-work.

Another Method to counterfeit Tortoise-shell on Horn.

TAKE of good aqua-fortis two ounces, and of fine silver one drachm; let the silver dissolve, and, after you have spotted or marbled your horn with wax, strike the solution over it; let it dry of itself, and the horn will be, in those places which are free from wax, of a brown or black colour. *Or,*

Lay the wax all over the horn; then, with a pointed skewer, or iron, draw what you will, laying the figure you draw open on the horn; then pour on the above solution;

let it stand a little, and, after you have poured it off, either scrape or melt the wax; wipe it with a clean rag, and polish it.

Instead of the solution of silver, you may boil litharge of silver in a strong lye made of quick-lime, so long, till it becomes of a black tincture: or, instead of silver, you may dissolve lead in aqua-fortis.

To solder Horn together, after it has been lined with proper Foils or Colours.

Take two pieces of horn, made on purpose to meet together, either for handles of knives, razors, or any thing else; lay foils of what colour you please on the inside of one of the horns, or, instead of foils, painted or gilded paper, or parchment; then fix the other piece upon it; lay a wet linen fillet, twice doubled, over the edges, and with a hot iron rub it over, and it will close and join together as firm as if made one piece.

To dye Horn of a Green Colour.

Take two parts of verdigrise, one-third part of salammoniac: grind them well together; pour on strong white-wine vinegar, and it will be tinctured of a pleasant green: then put your horn into it, and let it lie therein till you see it tinged to what height of colour you would have it. *Or,*

Take the green shells of walnuts; put them into a strong lye, with a little vitriol and alum, and let it boil for two hours; lay the horn for two days in strong vinegar; then put half an ounce of verdigrise, ground with vinegar, into the lye; boil the horn in it, and it will be of a fine green.

To dye Horn of a Red Colour.

TAKE quick-lime, pour rain-water upon it, and let it stand; pour it off clear, and put to it one quart of clean water, and two ounces of ground Brasil-wood; steep the horn therein, then boil it, and you will have a fine red, if you have soaked it for a while in alum-water, previously.

To stain Horn of a Brown Colour.

TAKE quick-lime, slacken it with urine, and wipe it over the horn; then take red curriers water, wash the horn therein, and it will turn to a green colour; wipe it over again with the same lime, and when dry, wash it with lye; let it lay therein a whole day, and it will be of a fine chesnut colour.

To dye Horn of a Blue Colour.

TAKE a brass bowl, and when you have made it red hot, wipe it over with sal-ammoniac; then pour lime water upon it, stir it together, and you will have a blue water, in which steep the horn; the longer you let it lie, the deeper will be the colour.

OF VARNISHING, OR JAPANNING ON WOOD, &c.

A White Varnish.

TAKE ten ounces of rectified spirit of wine, fine pulverized gum-sandarac two ounces, and clear *Venice* turpentine two ounces, put them together into a glass, and cover them close with waxed paper and a bladder; then take a pot with water, put it on a coal fire, and when it begins to be warm, put some hay at the bottom of the pot, on which set your glass; then let it boil for two or three hours, and the sandarac and turpentine will dissolve and unite with the spirits: then pour your varnish boiling hot through a clean hair cloth, and put it up in a clean phial for use. This is an excellent varnish, fit to be used for varnishing light colours, as white, yellow, green, &c.; and such things as are silvered or gilded.

Another Varnish fit to mix with Red or Dark Colours, and to japan the Work.

TAKE of rectified spirits, (that is such as when poured on gunpowder will fire it; or, when a linen rag being dipped into it, and lighted, will consume it,) one pound; of clean gum-lac, a quarter of a pound; grind it fine, and put it into a phial, and pour the spirits over it; let it stand for two days, shaking it once every hour; the third day hang it over a gentle coal-fire, till it is well dissolved; then strain it through a hair-bag, and put it up for use.

Another lac Varnish.

TAKE of the best proof spirit one quart, and calcined tartar one pound; let the spirit stand upon the tartar, close covered, for one day, in a gentle warmth; then pour off, and filtrate it through a paper; of this take one pound, white amber six ounces, sandarac six ounces, gum lac two ounces, (the amber must be picked out of the clear pieces) grind all fine together, put it into a phial or matrass, then pour on it three pounds of the filtrated spirit; your phial must be but about half filled; then shake it about for an hour together, and keep it in the matrass for two days, shaking it once every hour; when settled, pour it through a hair-cloth, and it is fit for use.

What sediment remains in the phial, may be used in making another such quantity of varnish, adding to it but half the quantity of fresh ingredients.

Another lac Varnish.

TAKE highly rectified spirits of wine one pint, gum lac four ounces, sandarac two ounces, white amber one ounce, white frankincense one ounce; powder these in a stone mortar very fine, and put them, together with the spirits of wine, into a phial or matrass, stopping it very close; set it in the heat of the sun, or, in winter-time, in a warm place, and after it has stood three or four days, set it on ashes over a charcoal fire; boil it softly for two hours, and when you see the spirits of a yellowish brown colour, and of a thick consistence, pour it hot through a hair-cloth, and preserve it in a clean phial for use.

A White or clear lac Varnish.

TAKE gum elemi, gum anime, white frankincense, and white amber, of each one drachm; grind them fine; put them into a glass, and boil them in distilled vinegar:—then pour off the vinegar, and wash the sediment with clean warm water, and it will be of a white colour; dry it, and grind it fine again; add to it one drachm of gum tragacanth, two drachms of white sugar-candy, both finely ground; put them by little and little into a matrass, wherein you have before put two pounds of rectified spirits of wine; and after you have put all the ingredients into it, shake it for an hour together; then put it into a *balneum mariæ*, and when it begins to boil, let it continue so for two hours; then let it cool; and after it is cold, let it stand for three days; decant it off into a clean phial,—stop it close, and it is then fit for use. *Or,*

Take the above specified ingredients; boil them in vinegar, as directed; and after you have put to it the gum tragacanth and sugar-candy, take of clear oil of spike, or turpentine, one pound, and of Cyprian turpentine six ounces; put them together into a strong matrass, and set it, furnished with a leaden ring, into a bath heat; when by that heat the turpentine is dissolved, add the other ingredients, finely ground, to it; stir them well together with a wooden spatula, and let them stand in the balneum for three or four hours; then take it out, and when cold, and it has stood two or three days, pour it into a clean phial, and you will have a fine varnish.

A fine Varnish for Blue, and other Colours, which will make them bright, like Looking-glass.

If your table is to be of a blue colour, paint it first over with indigo and white, ground with oil, and a little turpentine; when dry, you may give it another layer, and heighten or deepen it to your liking; and when this is thoroughly dry, varnish it with the following varnish:

Take clear Cyprian turpentine half an ounce, sandarac one ounce, mastich two ounces; grind the sandarac and mastich very fine; then take oil of spike two ounces, oil of turpentine one ounce, put them into a glass cucurbit, and dissolve it over a gentle heat; add to it the pulverized gum; set the glass, or matrass, into a pan with water; and let it boil over a slow fire for an hour, and all will be dissolved and united; then let it cool; preserve it in a phial, well stopped, for use.

When you use it; first wipe your painted table, and clean it from dust; then take some fine, and light, smalt in a cup, or upon a plate, according to what quantity your piece requires; temper it with the above varnish, and, with a large hair pencil, glaze it as quick as you can all over; let it dry in a clean place that is free from dust, which will be in about three hours time; then glaze it over again; the oftener you repeat it, the brighter will be your table; and if you will have it of an exceeding fine lustre, glaze it over twelve or fifteen times.

A Chinese *Varnish for all Sorts of Colours.*

PUT into a matrass a pint of spirits of wine, one ounce of gum anime, two ounces of mastich, two ounces of sandarac or juniper gum, powdered finely together in a mortar; then put them together into the matrass, close it up, and hang it, in hot weather, in the sun for twenty-four hours, or so long over a slow fire, till the gum is dissolved, and the spirits are tinctured; then filter it through a clean cloth, and keep it in a phial closed up. You may mix with it what colour you please; for red, use vermilion; for black, use lamp-black, or ivory black; for blue, use indigo, and white; Prussian blue, or smalt, and white lead, &c.

How to varnish Chairs, Tables, and other Furniture, to imitate Tortoise-shell; so as not to be defaced by Oil or spirituous Liquors.

FIRST lay a lac varnish over the work, as you have been instructed above; then lay it over again with red-lead and yellow-pink, well ground and mixed up with the said lac-varnish. You may do it twice or three times over, letting it dry thoroughly every time before you repeat it: after which, rub it with *Dutch* rushes, such as the joiners and cabinet-makers use.

Then take dragon's blood, which is a red gum; beat it very fine in a mortar, and temper it with this varnish: if you would be very nice, strain it through a fine hair-cloth, and put it up in a phial for use. The longer it stands, the finer the colour will be. With this, you may shade over your table, or other work, in the best manner you can: if you over-cloud it again, you must have a darker shade: and to deepen your shades, you may add to your varnish a little ivory-black, umber, or indigo; and work the colours together according to the best of your judgment. When you have done your work, and it is thoroughly dry, take some pumice-stone, and make it red hot, and beat it to a fine powder; with this, and *Dutch* rushes soaked in water, rub it smooth, and, afterwards, with a clean woollen rag. Holding it over a gentle heat, give it five or six more coats of varnish; but be careful it be not heated too much, lest it should blister, and spoil your work:—after it is thoroughly dry, take tin-ashes, *i. e.* putty, and sweet oil, and, with the rough side of *Spanish* leather, polish it; and give it the finishing stroke with some tin-ashes and the palm of your hand, wiping it till it has gained a fine lustre.

From this direction the artist will make further improvements.

A very fine Indian Varnish.

TAKE four or five quarts of such good spirits that, when you light a spoonful, will consume in flames, and leave nothing behind. Having this ready; take gum-lac, beat it fine, and put it to the spirit into a phial or matrass; let the spirit be four fingers high above the gum; close the glass, by tying a treble bladder over it; then put it on a hot sand-bath, and let it stand till the spirit and gum are well united and boiled; but be careful to see whether you perceive any bubbles rise to the top of the glass, for as soon as you perceive them, you must take a needle, and prick the bladder, in order to give it vent; else your glass will be in danger of bursting.

After which, filter it through a filtering paper into another glass, and keep it close stopped for use.

If you would use this varnish with colours, let them be first ground with rectified spirits; and temper as much of them as you have present occasion for with the varnish; lay it on your work, and when you think you have laid your varnish thick enough, polish it, when dry, with Dutch rushes; then give it a second polish with tripoli and sweet oil; afterwards give it another layer, or two, of clear varnish, and it will be fine, and answer the purpose.

To japan with Gold, Glass, or any other Metallic Spangles.

First lay on your work with lac-varnish; then grind Cologne-earth and gamboge with the same; this varnish must be bright and clear; with these colours lay your work once or twice over: let it dry, and then varnish it over, and sift on the gold-dust, or whatever else you design it for. If your work or table is large, lay the varnish on one place after another; for the varnish will dry in one part before you have done sifting over another. After you have sifted your work all over, and it is thoroughly dry, then give it twelve or fifteen layers more of clear varnish, after which, smooth and polish it, as directed.

A very fine Varnish for a Violin.

To do this in the best manner, you must have three glasses before you: in the first, put of the finest gum-lac eight ounces, sandarac three or four ounces, both very finely pulverized; upon this pour of the best rectified spirit of wine, so much till it stands four inches above the ingredients: when dissolved, strain it through a cloth, and place it, closed up in a still place, to settle; in a few days, the top will be clear, which you are to decant off in another glass, and preserve it from dust.

In the second glass, put of dragon's blood five ounces, and of red wood three ounces; make a solution and extract of them, with the same spirit of wine.

In the third glass, dissolve of *colophony*, i. e. common resin, three ounces, aloes two ounces; and when the whole is extracted, then pour the ingredients of the three glasses into one, stop them up, and let them settle; then pour off what is clear at top, and filter the rest through a brown paper. If you find the varnish too thin, exhale it a little over a gentle heat, and you will have a fine red varnish, which will gild pewter, and be of an excellent composition for varnishing of violins, &c.

A choice Varnish which cannot be hurt by wet.

Take of copal, as much as you please, beat it fine, put it into a glass, and pour highly rectified spirit of wine over it, four inches high; then close the glass with a bladder; set it for twenty-four hours in a warm oven, for the gum to dissolve; after which, put the glass in *balneo mariæ* till the spirits and the copal are incorporated.

A good Varnish for Paintings.

Beat up the white of an egg, with a dissolved piece of white sugar-candy, (about the bigness of a filbert) and half a tea-spoonful of brandy, till it becomes a froth; then let it settle for a little while, and, with the clear liquid, varnish over your picture; it is better than any other varnish, since it may be easily washed off again, when the picture wants cleaning, and be done afresh.

A fine marbling on Wood, or japanning.

Take of the best transparent yellow amber what quantity you please; beat it to a powder; put it into a clean crucible that is glazed within; let it melt over a gentle charcoal fire; and stir it well, to keep it from burning; then pour it upon a smooth clean marble table, let it cool, and beat it again to powder. Take afterwards clean turpentine, and, in a glass, warm it in a sand heat; put into it the beaten amber; let them simmer, and dissolve gently together, till they are of a consistence fit to be used with a pencil; strain them through a cloth, and you will have the finest varnish possible; and although it be of a brownish colour, yet when laid on, it has a fine clear gloss.

The colours wherewith you are to marble, are the following; lamp-black, brown-red, ochre, vermilion, which are to be ground with linseed oil; and white lead, ground with oil of almonds.

For a white; lay your first ground with linseed oil, and if there are any holes in the wood, fill them up with chalk tempered with size. For a black ground, lay it first with lamp-black and size; when the ground is dry, mix the vermilion with the above described varnish, and with a hair pencil lay it on with an even and quick hand; repeat this three or four times till it is bright and fine, and lay the varnish, by itself, over it twice, or thrice; then mix your other colours with the varnish, in an oyster-shell, or in little cups; and with them marble upon the ground you have prepared, in imitation of any thing you please.

A fine Gold Varnish, wherewith you may gild any silvered or tinned Articles, with such Lustre as if done with Gold.

TAKE of the finest gum-lac, in grains, eight ounces; of clear gum sandarac two ounces; dragon's blood, one ounce and a half; colophony, or black resin, one ounce and a half; beat all together into powder, and put it into a pipkin with a quart of highly rectified spirit of wine, which is strong enough to fire gun-powder; put it into a sand bath, and let it remain until it is dissolved as much as possible; then let it cool; strain it through a cloth, into a glass, so as to separate the dross that might have been in the ingredients. This varnish you may lay on every thing that has been silvered or tinned, three or four times, and it will resemble the brightest gold. If you would have the gold-colour still higher, you only add about two grains of turmeric, two grains of the best hepatic aloes, and one grain of the finest dragon's blood, boiling them up, and straining through a cloth into another glass.

When you would use it, set the glass into any vessel full of water over a gentle charcoal fire, in order to make the varnish fluid; it is also requisite to warm the work, before you begin to varnish it.

OF CORAL WORK.

To make Red Coral Branches, for the Embellishment of Grottos.

TAKE clear resin, and dissolve it in a brass pan; to one ounce thereof add two drachms of the finest vermilion; when you have stirred them well together, and have chose your twigs and branches, peeled and dried, take a pencil and paint these twigs all over, whilst the composition is warm, and shape them in imitation of natural coral, out of a black-thorn; when done, hold it over a gentle coal fire; turn the branch with your hand about, and it will make it all over smooth and even, as if polished.

In the same manner you may, with white lead, prepare white; and with lamp-black, black coral.

A gentleman may, at little expence, build a grotto of glass cinders, which may be easily had, pebbles or pieces of large flant, and embellish it with such counterfeit coral, pieces of looking-glass, oyster, muscle, and snail shells, moss, pieces of chalk, ore, &c. As to the cement to bind them together, you have directions how to prepare it under the article of cements.

PART VII.

THE ART OF

PREPARING COLOURS FOR PAINTERS,

WITH SEVERAL METHODS OF GILDING, &c.

OF BLUE COLOURS.

To make, or prepare, Ultramarine.

TAKE *lapis lazuli*, and calcine it in a crucible on a charcoal fire, and quench it in vinegar. Repeat this twice over; then grind it on a fine hard stone to an impalpable powder. When thus ground, take white resin, pitch, new wax, mastich and turpentine, of each six ounces; frankincense and linseed oil, of each two ounces, let them dissolve together over a gentle fire; stir them well with a wooden spatula, in order to unite them together; then pour them into clean water, continually stirring them; take them out, and preserve the mass, from dust, for use.

When you prepare your ultramarine, take twenty ounces of the above mass, to each pound of the pulverized *lapis lazuli*.

lazuli. The mass you are to dissolve before a gentle heat, by degrees in a pipkin, and fling the powder into it by little and little, whilst it is dissolving; after your powder is all in, and well incorporated, then pour it into a pan with cold water, and form it into little tents or drops; but to prevent its sticking to your fingers, you must anoint them with linseed oil; these tents or drops you are to put again into fresh cold water, for fifteen days, shifting the water every other day.

Then take and put them into a clean, earthen, well glazed cup or bason, and pour warm water on them; when that is cold, pour it off, and put fresh warm water to it; this you are to repeat until the tents or drops begin to dissolve, which will then turn the water into a blue colour.

When the water is of a fine blue tincture, and cold, then decant that into another clean earthen cup or bason, and pour more warm water upon the remaining tents; when that also is coloured, decant it off and pour fresh on, repeating this until the water receives no more tincture.

Let the tincture waters stand for twenty-four hours to settle, after which you will observe a greasiness on the surface; which, together with the water, you are to pour off gently, and put fresh clean water upon the sediment, mixing it well together, and straining it through a fine hair sieve into a clean bowl; the sieve will attract some of the slimy or greasy matter that might otherwise remain therein; so, after you have washed your sieve, and repeated the same thing with the next sediment, straining it through with clear water, three times successively, then let it settle; pour off the water and let it dry of itself. Thus you will have a fine ultramarine.

Another

Another Method, less Troublesome.

Calcine the *lapis lazuli* in a crucible; then grind it very fine on a porphyry. Mix up the powder with a paste made of wax, pitch, mastich, turpentine, and oil; and lastly, wash the paste well in clear water, to separate the colouring part from the rest, which precipitates to the bottom in the form of a subtile, beautiful, *blue* powder.

To know whether it be pure, if you buy any ready made; put a little of it in a small crucible, and on heating it red hot, if the powder keeps its colour, it is undoubtedly genuine: on the contrary, if any change be perceived, or any black spots appear, it is either spurious, or adulterated.

To prepare a curious blue Colour, little inferior to Ultramarine, from Blue Smalt.

Grind your smalt very fine, and proceed in every respect as you have been taught above, in preparing ultramarine.

To prepare a curious Blue Colour from Silver.

Hammer silver thin; neal it thoroughly, and rub it a little over with quicksilver; then put a little of the sharpest distilled vinegar, in which you have dissolved some sal-ammoniac, into a glass; hang the silver slips over it, so as not to touch the vinegar; cover it very close, and put it into a warm place, that the fumes of the vinegar may raise on the silver a very beautiful blue, adhering to the slips; wipe it off into a shell, and hang the silver slips over the vinegar again, well closed; repeat this, until all the silver is corroded.

Another Method.

TAKE of the purest silver what quantity you please, and dissolve it in good aqua-fortis; then evaporate half, and set the glass in a damp and cool place, and it will shoot into fine crystals; then decant the fluid clear from it, put the crystals into glass plates, and let them stand in a warm place until they effloresce, or run into a flour; then grind them with as much clear ammoniac, set them together in the open air, until you see the mass become of a blue or greenish hue; then put them together into a cucurbite with a large head to it, and sublime them. After this, grind the silver that is left at the bottom of the matrass with fresh ammonia, and sublime it as before; this repeat until all the fine blue is raised; then dry and preserve it. It is a fine and beautiful colour, fit to be used in the most curious paintings.

Another Method.

TAKE of the finest silver as much as you will; and dissolve it in clear aqua-fortis, in quantity as little as possible; when it is dissolved, evaporate, and the silver will remain at the bottom; pour over it some sal-ammoniac mixed with sharp white-wine vinegar; let it settle and turn clear; then pour off the vinegar, and keep the sediment at the bottom for a month, well closed up, to prevent the least evaporation, and you will find a very curious blue colour.

To prepare a Blue Colour from Verdigrise.

TAKE sal-ammoniac and verdigrise, of each six ounces; mix them well together with aqua-kali, into a paste, put this into a phial, and stop it close; let it stand for several days, and you will have a fine blue colour.

Another

Another Method.

TAKE sal-ammoniac one part, verdigrise two parts, beat them both to a powder, and mix them with a little white lead; then incorporate them together with aqua-kali; put them into a glass, and close it well; put the glass afterwards in a loaf, and bake it in a baker's oven; as soon as the loaf is baked enough, your colour will be ready. *Or,*

Take quicksilver two parts, sulphur three parts, sal-ammoniac four parts; mix and beat all well together; temper them with water, put them in a well glazed pipkin into a furnace, over a coal fire, and when you see a blue smoke arise, take it off and let it cool; then break the utensil, and you will find a fine sky-blue, not unlike ultramarine.

To prepare Blue Tornisel, or Turnsol, *a beautiful Colour.*

TAKE sloes, before they are full ripe, beat them into a paste, which put in a clean earthen pan: take another earthen pan, put into it a quart of water, three ounces of quick-lime, and a quarter of an ounce of verdigrise, and one-fifth of sal-ammoniac; let these things soak in the water until it is tinctured of a green colour. In twenty-four hours the lime and verdigrise will be sunk to the bottom, then decant off the water through a cloth, into another earthen vessel, add to it the paste of sloes, and let it gently boil over a slow fire; when cold, it will be of a fine sky blue; then pour that liquid into a clean pan through a cloth; set it on ashes, and when it begins to be of a thickish substance, then put it up in a bladder, and hang it up to dry. You may also dip clean soft linen rags into it; dry them in the shade; and when dry, repeat it again for three or four times; these preserve in paper; and when you have occasion to use it, soak one of these rags in a little fair water, and you will have a beautiful blue colour.

A Blue of Egg-shells.

TAKE egg-shells, calcine them in a crucible, beat them to a fine powder; put that into a copper vessel, and pour vinegar over it; which set into horse-dung for a month, and you will have a delightful blue.

To make Venetian *Sky-blue.*

TAKE of quick-lime one pound, mix and work it with sharp white-wine vinegar into a dough; let it stand for half an hour, and when hard, pour more vinegar to it, in order to make it soft; when done, add to it two ounces of good pulverized indigo; mix them well together; set it into a glass vessel for twenty days under horse-dung, after which time see whether it is of a fine colour; if not, set it again, as long as before, in the dung, and it will then come to its perfection.

Prussian Blue.

TAKE any animal matters, such as blood, the raspings of horn, clippings of skins, &c. &c. and convert them into a black coal, by heating them in a covered vessel, together with an equal weight of alkali.—Lixiviate this coal in water; then strain it, and evaporate to a degree of strong concentration. This lixivium is then to be gradually admixed to a solution of two ounces of martial vitriol, and four ounces of alum, when a bluish deposite will be formed, which is rendered more intensely blue, by treating it with marine acid. Manufacturers proceed on a much larger scale.

OF SEVERAL RED COLOURS.

Lake, or Laque.

A BEAUTIFUL red colour was originally prepared from *gum-lacca* or. *laque*, which has given the name of *lake* to all such colouring substances as are capable of attaching themselves to the earth of alum, and of being precipitated in the form of a red powder. Several such colouring substances have been employed, viz. madder, logwood, Brasil-wood, kermes, and cochineal; but the last is the principal one employed, concerning which we shall now treat.

Take two ounces of cochineal, and boil them gently in a quart of water; filtering the solution through paper, and adding two ounces of pearl-ash dissolved in half a pint of warm water, filtered also through paper. Make a solution of two ounces of alum in a considerable quantity of water (three pints at least.) Add this latter solution to the former, gradually, so long as any ebullition appears to arise; wash the red-coloured precipitate from the salts, in several quantities of fair water, and afterwards filter it through paper, and preserve the powder for use. *Or*,

Boil three pounds of the raspings of Brasil-wood with three pounds of common salt in three gallons of water; filter the hot liquor through flannel, and add to this a warm solution of five pounds of alum in four gallons of water. Now, dissolve, or have ready dissolved, three pounds of the best pearl-ash in a gallon and a half of water, and filter it also; and put the liquor to the other, gradually, till the whole colour is precipitated. If it be purple instead of red, add a fresh quantity of alum till a scarlet hue is produced; and then proceed with the sediment as in the former article. By the addition of half a pound of seed-lac to the solution of pearl-ash before it is filtered, a lake will be produced that will stand well both in water and oil, but is not so transparent in oil as without the seed-lac

The lake from Brasil-wood may be also made by adding half an ounce of Spanish anotto to each pound of the wood; but the anotto must be dissolved in the solution of pearl-ash.

A beautiful lake comes from China, but it does not work readily with oils, or water; it is however totally soluble in spirits of wine, and may be used in nice pieces of art.

To extract Lake from Scarlet Wool.

TAKE clean water, about six or seven gallons, dissolve therein as much pot-ash as will make it a good sharp lye, filtrate it through a felt, or flannel bag, to make it very clear; in this put the scarlet wool; let it boil well in a kettle, till it is white again, and the lye has extracted all the colour; then pour it again through a clean felt or rag, and squeeze out the wool; then take two pounds of alum, let it dissolve in water, and pour it in the coloured lye; stir it well together, and it will curdle and turn of a thick consistence; pour it again into a clean bag, and the lake will remain in the bag, but the lye will run clear from it; and in case it should still run coloured from it, you must let it boil with a little of the dissolved alum, which will wholly curdle it, and keep the lake back.

When the lake is in this manner in the bag, pour clear water over it, in order to clear it from the alum that may still remain in it; take a flat cake of plaster of Paris, or chalk; then strain the lake through a paper cone that has a small opening at the point, in little drops, or tents, upon it; and when dry, put them up for use.

You must observe, that in case the liquor should fall short in boiling the wool, you must recruit with *warm* water.

If you can get the parings of scarlet cloth, you will save yourself much trouble, by only boiling them in the lye, and proceeding as has been directed. This last method is practised by the French, in preparing their beautiful colour called *Carmine.*

To make fine Vermilion.

TAKE two parts of quicksilver, and one-third of sulphur; put them into a pipkin, and melt them together; when cold, grind it well upon a stone, and put it into a glass, which before-hand has been laid over with a coating of lute an inch thick; then make a coffin of clay, for the glass to stand in; set this on a trivet, over a slow fire; put a cover of tin, with a little hole in the middle, upon the glass, and lute it all round: put an iron wire through the hole, to stir it about; augment your fire by degrees, and watch your glass carefully; (for you will see a coloured smoke proceed from the matter in the glass); keep on augmenting your fire, till you see the smoke become of a red crimson colour, then it is enough; take it off the fire; let it cool, and you will have a fine vermilion.

Before you use it to paint or write with, take as much vermilion as you will, and grind it well with good white-wine, on a stone, and, after that, with the whites of eggs; add a little hepatic aloes to it, and make it up into little cakes; when dry, put them by for use. When you use them, grind or dilute them with clear pump water, and a little white of eggs; and if it will not flow readily from the pen, mix a little myrrh with it.

How to purify Vermilion.

THE vermilion being made of mercury and sulphur, the impurities which it has contracted from those minerals must be separated, and this is done in the following manner:

Grind the pieces of vermilion with water, upon a stone, and put them on glazed plates to dry; then pour urine upon them, and mix them thoroughly with it, so that it may swim over it; let it thus stand, and, when the vermilion is settled, pour off that urine, and put fresh upon it; let it stand all night; repeat this four or five days successively, till the vermilion is well cleansed; then pour the white of eggs over it, mix it up therewith, and stir it well together with a spatula of wood, and let it stand again; when settled, pour it off, and put fresh on; repeat this three or four times, covering your vessel every time close, to keep the dust from falling into it, which else would diminish the beauty of the colour: when you would use this vermilion, dilute it with gum-water. *Or,*

Grind vermilion in the urine of a child, or in spirits of wine, and set it to dry in the sun.

If you would have the vermilion of a high colour, and free from a black hue, put into the spirits, or urine, a little saffron, and grind your vermilion with it.

To make a fine Purple Colour.

MELT one pound of tin, after which put two ounces of warm quicksilver to it; stir them together, till it is an amalgam; then take sulphur and sal-ammoniac, of each one pound; grind fine, and mix it up with the amalgam, in a stone mortar or wooden bowl; put it into a glass which is well coated with clay, and set it, first, over a gentle fire, augmenting it by degrees, so as to keep it in one uniform motion; stir the matter with a stick, and, when you perceive it to be of a yellow colour, take it off the fire; let it cool, and you will have a fine gold colour, besides a beautiful purple.

COLOURS EXTRACTED FROM FLOWERS, &c.

How to extract Yellow, Blue, Violet, and other Colours.

PREPARE a middling sharp lye from lime, or pot-ash; in this boil the flowers, or leaves, of single colours, over a slow fire, till the tincture of the flowers is quite extracted, which you may know when the leaves turn pale, and the lye is of a fine colour. This lye put afterwards into a glazed pipkin or pan, and boil it a little, putting in some alum; then pour the lees off into a pan with clean water, and you will see the colour precipitate to the bottom; let it settle well; then pour that water off, and add fresh; repeat this till the powder is entirely cleansed from the lye and alum; and the freer it is therefrom, the finer will be your colour. The sediment is a fine lake, which spread upon linen cloth, on clean tiles in the shade, to dry.

You may dry your colours upon a plate of plaster of Paris, or, for want of that, on a piece of chalk; either of them will do to dry the colours quicker than the method above.

To the receipt for extracting the tinctures from flowers, leaves, herbs, and plants, by distillation, which has been already inserted, add, that it will be adviseable to preserve the first droppings that fall in the receiver, by themselves, as they yield the finest and most beautiful colour. Care must also be taken, not to bruise the tender leaves of the flowers, else the coarse juice will distil along with the tincture, and make it of an unpleasant hue. Such leaves that are firm and strong require not that care.

KUNKEL's *Method of extracting the Colours from Flowers, &c.*

TAKE highly rectified spirits of wine, and pour it over a herb, or flower; and, if the leaves of the plants are large and coarse, cut them small, but leave the leaves of flowers whole: as soon as the spirits are tinctured, and both colours of an equal tint*, put them together; but if they differ, set each apart by itself; after which, distil the spirits of wine from it to a very little, so as to take it off the cucurbit, and put it into a china tea saucer, a glass cup, or a small matrass, and so let it evaporate over a slow fire till it comes to some thickness, or, if you will, quite dry: this must be done very slowly, on account of the tenderness of the colour.

Some flowers will change their colours and produce quite different ones, and this the blue flowers are most subject to; to prevent which, one must be very slow and careful in distilling them. There is never so much trouble with any other coloured flowers as the blue ones, and yet there is seldom obtained a blue colour from flowers, to the satisfaction. The whole matter depends chiefly upon care: practice will be the best instructor.

By this method one may plainly see what flowers or plants are fit for use; for, by only infusing some in a little spirits of wine, it will soon shew what colours they will produce.

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* This direction is far from clear: it seems that the herbs and flowers are separately put in spirits; but the mixing of them is incorrect. *Ed.*

OF YELLOW COLOURS.

True Naples' Yellow.

Take twelve ounces of white lead, one ounce of alum, one ounce of sal-ammoniac, and three ounces of diaphoretic antimony; put them into an unglazed pipkin, and expose them in a moderate heat for the space of eight hours. Thus will a beautiful yellow be obtained, such as the artists of Italy term Giallolino.

Masticot, or Massicot.

Take any quantity of white lead; put it into a crucible, and expose it to a degree of heat that will turn it yellow, which may be exactly ascertained by inspection only

Orange Colour.

Boil four ounces of the best Spanish anotto, and one pound of pearl-ash, for the space of half an hour, in one gallon of water. Strain the tincture, and mix it gradually with a solution of a pound and a half of alum to six quarts of water, desisting when no ebullition ensues. Treat the sediment as is usual in preparing lake, and dry it in square bits, or round lozenges.

OF GREEN COLOURS.

How to make good Verdigrise.

Take of sharp vinegar as much as you will, of clean copper flakes one pound, salt three quarters of a pound, red tartar eight ounces, sal-ammoniac two ounces, leaven twelve ounces; beat, what is to be beaten, to a fine powder, and mix the whole with the vinegar well together; put it into a new well-glazed pan; cover it with a lid, and lute it with clay; then bury it for eighteen or twenty days in horse dung. Take it out again; pour off the vinegar gently, and you will have good verdigrise.

Another.

TAKE a well-glazed pan or pot, and put into it good sharp vinegar; then take thin copper filings, a pretty large quantity; put them into a crucible, and set the same into the pan with vinegar, so that the vinegar may not touch the copper; then lute the cover of the pan well with clay, to keep out the air; put the pan into horse dung, or into a warm place, for twenty-five days; then take it out again, and open it, and you will find the verdigrise hang to the copper filings; scrape the verdigrise off with a knife, and let it fall into the vinegar; after which, close up the pan again as you did before; put it into the dung, or a warm place, and thus repeat it till the copper is all consumed: the verdigrise will settle at the bottom of the pan, which, after you have gently poured off the vinegar from it, you may put up for use.

Another easier Method to make Verdigrise.

TAKE a copper kettle, or bowl, and put into it good sharp vinegar; set it in the heat of the sun to dry, and you will have fine verdigrise; after you have taken it out of the kettle, or bowl, you may pour on more vinegar, and repeat it as often as you think proper.

To make fine Verdigrise for Dyers.

FIRST, take four pounds of tartar, two pounds of salt, one pound of copper-ashes, one pound and a half of good vinegar; then take a crucible, or an unglazed pan; take a handful of tartar, and fling it into the crucible, also one handful of salt, and a handful of copper-ashes; fling in all, one after another, till the crucible, or pan, is full, then pour on the vinegar, and stir it well together, till the ingredients are thoroughly moist, and are turned of a black colour; cover the pan, and lute it close with clay, to prevent the air coming to it; put it for a fortnight, or three weeks, in hot horse dung, and you will have a good verdigrise. If you would have it dry, hang it up in a bladder, in the air. *Or,*

Take vinegar in which has been steeped some copper, and one pound of salt; mix the salt with so much vinegar as to make it of a consistence; then put it into a copper vessel; close it up, and set it in a damp place; and after it has stood some days, you will have a good verdigrise *Or,*

Take an old copper kettle or copper boiler, and scower it clean with sand; then take vinegar and honey, of each an equal quantity; mix them together, and strike the mixture all over the inside; then take salt, and sprinkle it upon the honey, so as to stick to it; have a board, made with a good many holes, and cover the kettle therewith; then turn your kettle with the board upon hot horse dung; cover it all over with dung, and let it stand for eight days together, and you will have fine verdigrise.

Fine Verdigrise for Painters.

TAKE copper-slips or filings, and put them into a strong copper-box, with a cover to it; pour some vinegar, mixed up with a little honey, into it; set it in the sun, or in a warm place, for fourteen days, and the vinegar will become blue: pour it into a glass, and close it well up: then put more vinegar and honey upon the copper-filings, and proceed as before, till they do not tincture the vinegar: what you have collected in glasses, put in the sun, or a warm place, till it becomes of a proper thickness; then grind it on a stone, and temper it with a little gum-water: if you would have it of a grass green, mix it with a little sap-green.

How to make Sap-green.

About a fortnight or three weeks before Michaelmas, take as many sloes as you please; mash them a little, and put them into a clean glazed pan; sprinkle them well over with powdered alum, and let them stand in a hot place for twenty-four hours; then pour upon them a clear lye, and put it upon a fire, and give it a slow boiling, till a good quantity is boiled away; then take it off the fire; let it cool, and pour it through a cloth; what comes through, put up in a bladder, and hang it in the air to dry; afterwards keep it always hanging in a dry place, or in the chimney corner; and when you have occasion to use it, take as much as you want and dilute it with clear water: if it should turn too much upon the yellow, mix it with a little indigo.

Another finer Sap-green.

Take of blue lilies that part of the flower which is of a fine blue colour (for the rest is of no use) and stamp them well in a stone mortar; then put upon them a spoonful, or according to the quantity of the leaves, two or more spoonfuls, of water, wherein before has been dissolved a little alum and gum arabic, and work it well together in the mortar; then strain it through a cloth; put it into muscle-shells, and set them in the sun to dry. *Or*,

After you have proceeded as before, fling some powdered quick-lime over it, before you strain it through the cloth, and put it in muscle-shells. *Or*,

Beat the blue leaves of lilies in a stone mortar; strain them through a fine cloth into muscle-shells, and fling some powdered alum over; to one more than the other, in order to make the colours of different shades.

To prepare a fine Green Colour.

TEMPER indigo and yellow orpiment with gum-water: grind it fine, and mix with it a little of ox or fish-gall, and you will have a pleasant green. You may shade it with indigo or sap-green, and heighten it with Dutch pink.

A good and cheap Green.

To one pound of blue vitriol dissolved in a sufficient quantity of water, add immediately one pound of purified alkali, and five ounces and a half of pulverized white arsenic, dissolved previously in eight pounds of boiling water: the precipitate, arising from the mixture of the two solutions, is to be washed, and dried. It mixes readily with oils, and is much cheaper than any other green colour.

OF WHITE COLOURS.

To make fine White Lead.*

TAKE some sheet lead, or, rather, milled lead, and cut it into plates of about two inches wide, and six or eight inches long; make through each of them a hole, to draw a string through, to hang them in an oaken vessel, about two feet high, into which put two quarts of good vinegar, in another vessel, and cover it; set it over a gentle coal fire, and let it be boiling hot; then take it off, and put it for ten days in a warm place; then take off the cover, take out the plates, and they will be covered with a white colour on both sides, a finger thick, which you are to scrape off with a knife, and put into a clean bason; then hang the plates up again in the wooden vessel, and proceed as before, scraping the colour once every ten days: grind the colour in a stone mortar, with clean water, to a paste, and put it up in clean pans to dry.

Another Method to make White Lead.

TAKE long and flat pieces of lead; hang them in a Merton stone-ware pan, and, before you hang the lead in the vessel, pour into it good vinegar, heated; cover it close, and lute it to keep out the air, and put it in a warm place, for a month or five weeks; then take off the cover, and scrape off the white lead: this you may repeat every fortnight or three weeks, and you will have good white lead.

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* The preparing of *white lead* is so pernicious to health, that we strongly recommend it to the reader to buy it ready prepared; and, indeed, most other articles that can be purchased readily. *Ed.*

Another Method of preparing White Lead.

LET pieces of milled lead be rolled spirally, so that the space of an inch shall be left between each circumvolution, and place these pieces vertically in earthen pots of a fit size, containing some good vinegar. Support the rolls of lead within the pots, so as not to let them touch the vinegar, but freely receive its fumes within the circumvolutions. The pots are now to be placed in a bed of dung, to raise a gradual heat, by which the surface of the metal may become corroded with a beautiful white pigment called *ceruse*. When this ceruse is duly ground and washed, it becomes the ordinary *white lead* of the shops. It is, by some, called *flake white*, from its falling off the corroded lead in flakes or scales.

Nottingham White.

THIS very durable white is said to be prepared at Nottingham in a similar way to the method described above, with this only difference—that sour ale, called alegar, is used instead of vinegar. Whether this virtue in alegar is owing to the hops originally boiled in it is not determined, but it is highly probable, because vinegar is usually prepared from malt, as well as ale, but without the addition of any hops.

By absolute experiment, it has been verified that this white keeps its colour for a greater length of time than any other kind of white lead.

To prepare another White Colour.

TAKE quick-lime, and mix with it calcined egg-shells; grind these two ingredients with goat's milk, very fine, and it is fit to paint with.

A good White Colour.

TAKE crown glass, and beat it to an impalpable powder; take also finely pulverized sulphur; mix them together into a large crucible with a cover to it; lute it close, and put it upon a charcoal fire, so as to make the crucible red hot all over: when it is thus heated, take it off the fire, and let it cool; then take off the cover, and grind the matter upon a stone with clear water, and temper it either with oil or gum-water: it will give a good white colour.

A fine White Colour for painting in Miniature.

TAKE four ounces of good bismuth, and beat it fine; then dilute it in eight ounces of the best aqua-fortis; pour the solution into a glass, and put a little salt water to it, and the bismuth will precipitate to the bottom, in a snow-white powder; pour off the water, and sweeten the powder well with clean water from the sharpness of the aqua-fortis; then dry it, and keep it carefully from dust; when you use it, dilute it with gum-water. This is the *magistery of bismuth*, used by the ladies for a cosmetic; and is termed, by artists, *Spanish white*. It is apt to turn black, although it is at first a beautiful colour.

How to refine White Lead.

TAKE fine white lead, and grind it upon a stone with white-wine vinegar, and it will turn black; then take an earthen dish full of water, and wash your ground white lead well, and let it settle; then drain the water gently from it, and grind it once more upon a stone with vinegar, and wash it again: repeat this three or four times, and you will have a curious fine white, fit for the nicest work, both in oil and water colours.

How to prepare Egg-shells, for a White Colour.

Soak the egg-shells three or four days in good sharp vinegar; then wash them in clear water; dry them in the heat of the sun; beat them into a fine powder, and grind them on a stone.

White for Water-colours, fit for Paper-stainers, &c.

Pour a small quantity of strong nitrous acid upon litharge in a glass vessel, and the acid will unite itself to the metal with strong effervescence and heat. Some water being now poured on, and the glass vessel being shaken, a turbid solution of the litharge is made. If a small quantity of acid of vitriol be now added, it throws down a beautiful *white powder*; and the acid of nitre being left at liberty, to act upon the remainder of the litharge, begins anew to dissolve it with effervescence. When it is again saturated, which will be known by the discontinuance of the bubbles, more acid of vitriol is to be added, by drops, and more of the *white powder* is formed. Thus may you proceed, till all the litharge is converted, by the alternate use of the two acids; and if the process has been neatly managed, an ounce of nitrous acid may be made to convert several pounds of litharge into a *white powder* of great value.

OF SEVERAL BLACK COLOURS.

To burn Lamp-black, in order to make it finer, and of a better Colour.

Take a fire shovel, and hold it in the fire till it is red hot; then fling your lamp-black upon it, and when it is done smoking, it is enough.

How to make a finer Lamp-black than is ordinarily sold in Colour Shops.

Have a lamp with a large wick of cotton, stored plentifully with oil; fix over the lamp a sort of canopy, made of tin or iron; the smoke which settles to it, sweep off with a feather, and preserve it from dust. When you use it, temper it with oil or gum-water.

To make a Black of Trotter-bones.

Take as many trotter-bones as you please, and burn them in a close crucible, and quench them in damp linen rags; grind them with fair water, before you use them with it: this black is fit to be mixed with lake and umber, for shades in carnation or flesh-colour.

To make Ivory-black.

Take the shavings or raspings of ivory, which you may easily have at the comb-makers: mix them up with a little linseed oil; put them into a pan, or crucible, and lute it close, leaving only a little hole in the middle of the cover; set it on a coal fire, and let it stand till you perceive no more smoke, then take it off, and set it in sand,

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putting another pan or crucible over it; when cold, you will have the finest black colour that can be prepared.

Another Method to burn Ivory either Black or White.

FILL a crucible with the wastes of ivory or hartshorn; lute it well, and put it in a fire, and when the phlegm, spirit, oil, and salts have fled, it will be of a very fine black colour; but if you keep it longer in the fire, it will turn white.

A Cherry-stone Black.

FILL a crucible with cherry-stones, and cover and lute it well; let them dry first by degrees, then burn them to a coal; afterwards beat them to powder, and moisten them with gum-tragacanth water; form them into little balls, ready to be used, either for oil or water colours.

To make Indian Ink.

TAKE dryed black horse beans, and burn them to a powder; mix them up with gum-arabic water, and bring them to a mass; press it in a mould made for that purpose, and let it dry. *Or,*

Take one ounce of lamp-black, two ounces of indigo, half an ounce of fish black; grind them with half water and half milk, and a little gum-arabic, and form tables thereof. The lamp-black must be cleared from all greasiness, by burning it in a clean pan, on a coal fire.

To make a fine Ink-powder, to write or draw with.

TAKE half an ounce of lamp-black; plumb or cherry-stones, vitriol, and gall-nuts of each half an ounce; burn them together in a crucible; add half an ounce of gum-arabic: beat all in a mortar to a fine powder, and sift it through a fine sieve; then put it up in a box, and, when you want to use it, dilute it with fair water.

SEVERAL METHODS OF GILDING.

A particular way of Gilding; in the open Air, where Leaf-Gold cannot be managed, on account of the Wind.

TAKE thin pewter leaves, or tinfoil, and strike them over with gold size, and gild them; and when you are obliged to gild any thing that is high, and you have no shelter to keep off the wind, lay these on size something stronger, in order to make the gilt leaves stick on the better.

How to prepare the Size for gilding in burnished Gold.

TAKE two pounds of cuttings or shreds of white glove leather; let them soak for some time in fair water, and then boil them in a pot with ten quarts of water, to two or three quarts; then strain through a cloth into a clean earthen pan. You may try whether the size be strong enough, by taking a little between your fingers, to see whether it is of a gluish consistence, and whether it will stick. Add to this size a due quantity of whiten, to make a paint of it.

How to gild in burnish upon Wood, Picture-frames, or any other Sort of Work.

THE wood must be first well smoothed, and then several times struck over with size and whiten; when dry, rub it well over with Dutch rushes, to make it even and smooth ; then with a soft hair pencil lay it over with size water ; after which lay on the gold coloured ground, twice or three times ; when it is thoroughly dry, rub it over with a linen rag, till it looks polished : then have your leaf gold ready cut upon a leather cushion ; and when, with a large pencil, dipped in the strongest brandy you can get, you have gone over your work, be nimble in laying on the gold : when it is quite dry, polish it with a tooth.

How to prepare the Nurimberg Metallic Powder, *which gives a beautiful Lustre, when strewed upon Writing, or Letters.*

TAKE the filings of copper, brass, iron, steel, or any other metal ; sift them through a fine sieve, and put them into a clean bason or such like vessel ; wash them well with a clean and sharp lye, and, when you have poured that off, wash them with clean water, till you have cleansed them from all its effects.

After your filings are thus cleansed and dry, take a smooth plate, either of iron or copper ; lay it upon live coals, and put one sort of the filings upon the plate, stirring it continually about, with an iron spatula : as soon as the metal is touched with the heat, it changes into a variety of colours, and that which suffers the greatest heat will take the darkest colour ; each metal different.

When you have done one sort, proceed in the same manner with another ; by which means you will have variety of colours.

Then take a flatting-mill, such as the silver-wire drawers use, or those employed in flatting of gold, silver or copper-plate ; fit it with a sort of funnel at top, through which the filings may be conveyed to the flatting rolls ; (which ought to be very exact, and parallel to each other, made of the finest steel, and polished like a looking-glass.) When you are thus prepared, work it with carefulness between the rollers, and you will have a most beautiful powder, which sparkles with all sorts of colours.

The filings of brass produce a bright gold colour; the copper, a fine red fire-colour; iron and steel, various shades of blue; pewter, marcasite, and bismuth, produce a white colour.

How to bronze Images of Plaster of Paris.

TAKE isinglass, and steep it in very strong brandy; put it, well closed, in a warm place, and it will dissolve; add to it a little saffron, and mix it up with *metallic powder* in a muscle or oyster shell; strike this over your image, with a soft hair pencil; but before you do this, wash it over with size-water, mixed with a little red-lead.

To spot a White Horse with Black Spots.

TAKE of litharge three ounces, and of quicklime six ounces; beat them fine, and mix them together; put the mixture into a pan, and pour a sharp lye over it; then boil it, and you will have a fat substance swim at top, with which anoint the horse in such places as you design to have black, and it will turn of that colour immediately.

It has the same effect in changing hair that is red into a black colour, with only this difference, that you are to take an equal quantity of lime and litharge, and, instead of boiling it with lye, boil it only with fresh water: what swims at top, is fit for use, and will answer your expectation: what hairs you anoint with it in the evening, will be black the next morning.

How to dapple a Horse.

TAKE, in the spring-time, the large buds of young oak-trees; mix them among the horse's provender, and give it him three or four times to eat, and he will be dappled, and continue so for a whole year: the buds of young-elm trees will have the same effect.

PART VIII.

SEVERAL CHOICE CURIOSITIES.

A particular Method to furnish a Fish-pond with Variety of Fish.

TAKE, about the latter end of April, or the beginning of May, the root of a willow that stands near the water side, and is full of fibres; wash the earth about it clean away; then tie it to a spike, which drive into a river or fish-pond that is well stored with variety of fish: they will presently strike about, and against the root, and void their spawn or roe, which will hang to the fibres; after a few days, take the spike, with the willow-root, out of that river or fish-pond, and convey it to that which you design to store, driving it about a hand's breadth deep under the surface of the water; and in about a fortnight's time you will perceive a great number of young fish. Be careful that you leave the root not too long in the first pond or river; lest the heat of the sun animate the spawn, and disengage it from the root.

To illuminate an Apartment with various beautiful Colours.

Put three or four prisms, or glasses, together in a triangular form in a frame, so as to make it portable: let the prisms be so fixed to your corners, that on one side they make a flat, and on the other a trigonal face, or three-sided figure; place this frame, thus finished, under a window, towards the sun, so that the flat side be towards it; and if there be any more windows in the apartment, let them be shut up. As soon as the beams of the sunshine through these trigonal glasses, your apartment will appear like a paradise in the greatest beauty, and of various colours. If you receive the beams on a concave glass, you will see the colours change quite different from what they were before; and if you look through these glasses into the street, you will see every thing in different colours.

Arbor Dianæ, or the Philosophical Tree.

Take one ounce of silver, and dissolve it in two or three ounces of acid of nitre; put the solution into a matrass, or glass phial, into which you have put eighteen or twenty ounces of distilled water, and two ounces of quicksilver. Let your phial be filled up to the neck, and place it in some convenient place where no body can meddle with it, for forty days together, in which time you will see a kind of tree spread forth its branches, resembling vegetable ramifications.

Another Method.

Dissolve an ounce of fine silver in three ounces of aqua-fortis, in a phial or small matrass; evaporate about half that moisture in warm sand, by a gentle fire; add to it three ounces of good distilled vinegar; heat it a little, and stir it about; then put your matrass in a place where it may rest for a month, and you will see a tree growing to the very surface of the liquor, resembling a fir-tree.

Another Method, much shorter.

MAKE an amalgam, without heat, of four drachms of filings of silver, or, what is still better, of silver leaf, and of two drachms of mercury: dissolve this amalgam in four ounces, or a sufficient quantity, of acid of nitre, pure and moderately strong; dilute this solution with a pound and a half of distilled water; shake the mixture, and preserve it in a bottle with a glass stopple: when this preparation is to be used, put an ounce of it in a phial, together with about the size of a pea of an amalgam of gold or silver, which ought to be as soft as butter; let this remain at rest: soon afterwards, small filaments will be seen issuing from the small amalgam, which quickly increase, and branch out on both sides, in the form of shrubs.

Another Method, less fallible.

DISSOLVE six drachms of silver in nitrous acid, and four drachms of quicksilver in the same acid; let both the solutions be saturated with their respective metals, and then let them be mixed together: add to this mixture five ounces of distilled water, and pour it into an earthen vessel, upon six drachms of amalgam made up of seven parts of quicksilver, with one part of silver leaf. Set it at rest, as before, and the effects will be beautiful.

To preserve Things from Corruption.

THIS is done in highly rectified spirit of wine camphorated; wherein many sorts of animals, birds, fishes, insects, reptiles, &c. may be kept many years. *Porta* relates, that he had seen a fish at Rome thus preserved for above twenty years, which was as fresh as if alive: likewise at Florence he saw one that had been preserved above forty years. The glasses, wherein they were kept, were hermetically sealed, to keep the air from coming to them.

The Preparation of the Spirit or Oil of Salt, a preserver of Things from Corruption, and a great restorer & preserver of Health.

TAKE sea-salt, as much as you please, put it into a crucible, covered, over a good coal fire, and when it has done crackling, take it off, put it in a damp place till is is dissolved, filter it often through a paper, till it is thoroughly clear and fine. Then let it digest in horse-dung, for about two months, changing the dung often for fresh, in order to keep it continually warm. Then distil it over some sand, and you will have in your receiver a salt oil, with a watery phlegm, distil this gently in a water bath, and the oil will remain behind, but the watery substance be carried off; [*] whatever is put into this oil, will keep from corruption without changing, for ages. This is the salt spirit which by *Paracelsus* is called *Viriditas Salis*, and has incomparable virtues, as well to restore men to health and vigour, as also to preserve them from most distempers; four or six drops taken in wormwood water, is good for the dropsy, convulsions, and the yellow jaundice; three or four drops taken in hartshorn water is good for all sorts of agues; for worms, it is taken in brandy; three drops taken in water of *Carduus Benedictus*, is good for the stoppage of urine. It is a fine remedy for all sorts of sprains and contractions of the nerves; it heals bruises and swellings, when mixed with other ointments, and the affected parts anointed therewith. When mixed with oil of turpentine or wax, or cammomile, it will assuage the gout.

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[*] This will be found to be no more than a pure and highly concentrated *brine*, with no greater virtues. The same may be made, by mixing pure crystals of kitchen salt with distilled water. *Ed.*

But if this preservative is too costly to keep things from corruption, you may prepare a sea-water at a small expence, which will keep things for many years; and this you may do in the following manner:

Dissolve sea-salt in distilled rain-water, and make a lye which will bear an egg.

Or, when the salt is decrepitated, put it into a damp place, and when it is dissolved, filter it through a paper till it is clear and fine. This you may use to preserve things from corruption, by distilling it, and pouring it over the thing to be preserved.

A Reg[illegible] *of Coral.*

Take verdigrise three pounds; sulphur vivum one pound; washed and clear sand four pounds; pulverize and mix them; then distil them in a retort on sand, first with a slow fire, but augmenting it by degrees; it will produce a spirit, which has a sweetish-sour flavour.

If you pour this spirit upon powdered coral, or hartshorn shavings, which by a gentle warmth is quite dried up, and put it into a phial with some distilled rain-water, and set it in a warm place well closed up, the coral or hartshorn will shoot and grow so naturally that it will be a delightful sight.

To make Phosphorus.

TAKE bones which have been burnt white, reduced to powder, and passed through a fine sieve: then mix them in a vessel of stone ware, with an equal quantity of the strongest acid of vitriol, and as much water as will make the whole into the consistency of clear soup: let the mixture be at rest for some hours, and it will become thick; pour it now upon a filtre of double linen cloth, and wash it through with water till it pass clear and tasteless, which is a sign that no acid of phosphorus is left in the residue on the linen cloth. Evaporate the superfluous water, and a white matter will sink to the bottom, which must be taken out and washed in fresh water, till it becomes tasteless: proceed with the evaporation till no more white matter sinks, washing carefully the sediment, and throwing away, and returning the clear liquor to the other clear liquor: lastly, evaporate all the clear liquor to the consistency of honey, or a soft extract. Mix this thick matter with one third of its weight of powdered charcoal; put the mixture into a stone ware retort, to which a receiver full of water has been properly luted, and distil. Fire is gradually applied till the retort is first reddened, and then rendered white; the phosphorus then runs in drops, and the operation lasts about nine or ten hours, or more, according to the quantity of matter distilled, and the degree of heat which the furnace is able to bear. Six pounds of bone-ashes will usually yield a trifle more than three ounces of pure phosphorus.

Another Method to prepare Phosphorus.

TAKE of urine as much as you please; put it into a tub or kettle, and let it stand for three weeks or a month together to putrify; then boil away the humidity, till the remainder becomes a black and tough matter. Of this take one pound, oil of tartar fœtid, or the stinking oil of hartshorn, or for want of that, green wax; mix it well with the matter, and put it into a retort; set it on a strong fire of a reverberatory furnace; fit to it a large receiver, and lute the junctures; give first of all a gentle, and, lastly, for four hours, the fiercest, heat you can; you will find in the receiver, first, sediment, then volatile salt, then some oil, and after that the phosphorus, which in the receiver is sublimated of a yellowish colour: let the first sediment stand over night and grow cold; then take and wash, with the liquor that is at the bottom, all the phosphorus and oil; mix them well together, and put them into a matrass; distil them on a sand-bath, and you will find, first, sediment grains of phosphorus, which, whilst warm, form into little sticks, and preserve in a phial, closely stopped with a glass stopple.

Another Process for making Phosphorus.

Take a considerable quantity of human urine, and digest it for a pretty while, before you use it; then distil this liquor, with a moderate heat, till what remains in substance be brought to the consistence of a syrup; incorporate this with thrice its weight of fine white sand, and put it in a strong stone retort; to which join a large receiver, filled in a great measure with water, so that the nose of the retort may almost touch the water, then lute the two vessels carefully together, and give the whole a graduated fire for five or six hours, to bring over all that is volatile; this done, encrease the fire, and at last for five or six hours more make it strong and intense as possible you can, by which means there will first come over a large quantity of white fumes, which in a little time will be succeeded by another sort seeming to yield a faint bluish light in the receiver; lastly, the fire being vehement, there will come over another substance more ponderous than the former, and fall to the bottom of the receiver, which is the real phosphorus. Preserve it as the former.

Another luminous Matter.

TAKE what by most apothecaries is called *land emerald*[*], as much as you will; beat it fine with water on a stone; temper it with gum or honey-water, and write or paint therewith upon a polished copper or iron plate, whatever you will, and let it dry; then lay it upon a charcoal fire, or set it before the same, and in a little while it will shine, so that when you bring it into a dark room, or put the candles out, the company who are ignorant of what is done, will be surprized at the sudden and strange appearance.

To prepare a Room or Closet, in such a Manner that any one, entering with a lighted Candle, will think himself surrounded by Fire.

TAKE a pretty large quantity of brandy, and put it in a bowl; set it on a slow coal fire, to receive heat enough to boil it gently up, into the brandy fling some camphor, cut in little bits, which will soon dissolve; when all is dissolved, close the windows and doors, and let the brandy boil and evaporate; by this the whole will be filled with subtle spirits, which, as soon as a candle is brought in, will be lighted, and seem as if on fire. If some perfume is dissolved in the brandy, the flame will give out a fine scent.

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[*] *Land Emerald* is expunged from the Pharmacopœia. *Ed.*

To prepare a luminous Stone.

TAKE good acid of nitre, and fling quick-lime and chalk into it, till it can dissolve no more, and ceases to bubble; filter the solution; put it into a retort, and distil the acid of nitre from it again; what remains in the retort, place in the air, and let it dissolve; then put it again into the retort, and draw off the moisture till it is dry; set it again in the air, and let it dissolve; then put it into a cup, and distil all the moisture from it; what remains put under a a muffel to harden. Then hold it in the light of day, or of the moon, or the light of a candle, and it will emit light, when put into a dark place.

The Preparation of Pyrophorus.

LET three parts of alum, and one part of fine sugar be rubbed and mixed together. This mixture must be dried in an iron shovel, over a moderate fire, till it be almost reduced to a blackish powder, during which operation it must be stirred with an iron spatula. Any large masses must be bruised into powder, and then it must be put into a glass matrass, (See A. fig. 9. plate 4.) the mouth of which is rather strait than wide, and its length seven or eight inches. This matrass is to be placed in a crucible, or rather earthen vessel, large enough to hold the body of the matrass, with a space about equal to a finger's thickness around it. The space is to be filled with sand, so that the matrass shall not touch the earthen vessel: the apparatus is then to be placed in a furnace, and the whole to be made red-hot: the fire must be gradually applied, that any oily or fuliginous matter may be expelled. After which, when the matrass is made red-hot, sulphureous vapours exhale: this degree of heat is to be continued till a truly sulphureous flame, which appears at the end of the operation, has continued nearly a quarter of an hour: the fire is then to be extinguished, and the matrass permitted to cool, without taking it out of the earthen vessel, or crucible; and when it ceases to be red-hot, it may be stopped with a cork. Before the matrass is perfectly cold it must be taken out of the earthen pan or crucible, and the powder it contains is to be poured into a very dry glass phial, and well stopped with a glass stopple. The phial should be seldom opened if this pyrophorus be intended to be preserved for a length of time. Should the powder kindle whilst it is pouring into the phial, which sometimes happens, merely close the mouth expeditiously with the stoppel; and the flame will be extinguished.

The Preparation of a Species of Pyrophorus.

Take an earthen plate or dish, which is not glazed, about half an inch thick; make a sort of paste of acid of nitre and pulverized chalk, well stirred together; of this take the quantity of a shilling, and put it into the plate, and set it on the fire under a muffel, (where it will bubble very much); when dry, take it out, let it cool, and mix it up with acid of nitre; this do six or eight times, and it is done: after it is cold, hold it a little while against a candle; then, shewing it in a dark place, you will be surprised at the light it gives.

How to prepare Thunder Powder.

This is done with three ingredients, namely, three parts nitre, two parts of salt of tartar, and one part of sulphur; these are pounded and mixt together: if you take about sixty grains, in a spoon, and warm it over a candle, or other fire, it will give a report like a cannon: if you make use of a copper spoon, or cup, you may, after the report, find a hole at bottom: when fired at top, it will burn away like lightning, without any report.

To prepare a Stone, which being wetted, produces Fire.

TAKE quick-lime, nitre, tutty, and calamine, equal quantities; sulphur and camphor, of each two parts; beat them fine, and sift them through a fine sieve; then put the powder into a new linen cloth, and tie it close; put it into a crucible; cover it with another crucible, mouth to mouth, and bind and lute them well; then set them in the sun to dry. Then put the crucible into a potter's furnace, and, when cold again, take it out, and you will find the powder altered into the substance of a brick; this you may form into less proportions; and, when you have occasion to light a candle, or fire, wet part of it with a little water, or your own spittle, and it will instantly flame: when you have lighted your fire, you may blow it out again, as you do a candle.

To represent the four Elements in a Glass Phial.

HAVE a glass made in the shape of an egg; fill a fourth part with clean smalt, or common antimony, to represent the earth; for water, take oil of tartar; for the air, spirit of wine three times rectified; and oil of Benjamin, in colour and brightness, may represent fire; the cover of the glass may be ornamented with a flame, or what you please.

A Florence flask will answer the same purpose, with a foot adapted to it.

An elementary World in a Phial.

TAKE black glass, or enamel, and beat it to a middling gravel size: this, for representing the earth, will settle at the bottom; for the water, you may use calcined tartar, or sand-ashes, which you must first moisten, and what dissolves pour the clearest off into the phial, and tincture it with a little ultramarine, to give it the sea colour; for the air, use spirits of wine, tinctured with a little turnsole, which gives a sky colour; to represent the fire, take linseed oil, or oil of turpentine. All these materials differ both in weight and quality, for, if you shake them together, you may indeed observe a little while a chaos of confusion and disorder, but as soon as you set the phial down, each ingredient takes its respective place in the same order as before.

To ornament a Room with a continually moving Picture.

PLACE a large picture against a wainscot, in a summer-house, or any other room where the wind may be conveyed to the back of the picture; bore little holes through the wainscot, to correspond with some paste-board wheels that are at the back of the picture: the wind which blows on them through the little holes, will put them in motion. Having, on the right side of the picture, subjects painted and fixed to the paste-board wheels on spindles, they will have an equal motion with them: there may be several things represented in the picture, and their motions made agreeable; as for example, a man grinding of knives, a woman at her spinning-wheel, a wind or water mill, and several other fancies.

To make Microscopes to great Perfection.

TAKE a lamp with spirits of wine, and, instead of cotton, use very small silver wire, doubled up like a skein of thread: then take of beaten glass, after it is well washed and cleansed, a little quantity on the point of a silver needle filled very small and wetted with spittle; then hold the bit of glass in the flame of the lamp, till it is quite round, but no longer, for fear of burning it; if the side of the glass next the needle is not melted, then turn the rough side to the flame, till it is every where equally round and smooth; then wipe and rub it with soft leather, and afterwards put it between two pieces of thin brass, with apertures very round; that towards the eye must be almost as large as the diameter of the glass: place it in a frame, with the object.

How to extract the Quintessence of Roses.

TAKE fresh roses, which are gathered before sun-rising, whilst the dew is upon them; bruise and stamp the leaves in a stone mortar; then put them into an earthen glazed pan or bowl; cover them close, and let them stand till they putrify, which you will perceive when the scent is sour (it turns so in about twelve or fourteen days.) You may mix up with the leaves a little salt of tartar, for this penetrates, and will cause each the better to separate.

After the rose-leaves are thus putrified, take the fifth or seventh part of them; put them into a glass cucurbit, and distil them in a sand-bath. Pour the distilled water upon the other part of the leaves; and, after you have emptied the cucurbit of the first leaves, put in the second part, and distil them, as before; thus repeating it, you will draw a rectified water, which contains the spirit, to be separated in the following manner: put all the water you have distilled into a matrass with a long neck; add a head to it, and lute a receiver to it, then, with a slow ash-fire, draw off the spirit; and, as there will go some of the phlegm along with it, it must be distilled again with a slower fire: thus you will have a pure spirit of roses, which will diffuse its strong scent, as soon as the matrass is opened, over the whole room.

Save this spirit, well closed up, in a phial, as a precious and valuable thing; for its virtue is admirable. Pour the greater part of the distilled rose-water over the already distilled rose-leaves, in order to extract the oil from the water; which must be done by distilling it over a hotter ash-fire than you did the spirit: the oil will separate itself from the phlegm, and swim on the surface of the water, of a golden colour; and although the quantity be but small, the virtue is great and valuable.

Separate this oil from the phlegm, and put it up by itself, and the distilled rose-water in a glass by itself; after which, take the distilled rose-leaves, from which all the spirit and oil is extracted, and burn them in a crucible to ashes; in burning, add a little sulphur to them; give the ashes a fierce fire, and they will be as white as snow.

These ashes put into a glass or earthen vessel; pour over them the above phlegm or rose-water; boil it well, till the water has extracted all the salt from the ashes; then filter it through paper into a matrass; distil it, and carry off the phlegm, and a clear salt will settle at the bottom of the matrass: the ashes you may calcine anew in a strong reverberatory fire, then boil them up again in the phlegm, and draw out the salt, as before; repeat this till all the salt is extracted, and there remains only an earthy substance.

In this manner are extracted from roses the three principles, spirit, oil, and salt; and the three impure parts, phlegm, water, and earthy residuum.

If the salt should not be clean enough, you must dissolve it again in the phlegm, and repeat your process by distillation, as before, and you may make it as fine as you will *.

Another Method to extract the Quintessence of any Vegetables.

TAKE a plant, herb, or flower in the month in which they flourish best; gather them before sun-rising, with the dew upon them; chop them fine, and fill therewith a glass matrass; lute the head over it, and place the matrass in a sand-bath; let it digest over a very slow fire for a fortnight, after which time augment your fire; when you find some will go over into the receiver, then take your matrass out of the bath, and you will see the herb infused in its own juice, which pour off into a clean glass; what remains of the herb take out of the matrass; burn it to ashes, and extract the salt with water, and evaporate to dryness.

How to extract Oil from Herbs, Flowers or Seeds.

FILL a large cucurbit with herbs, flowers, seeds, or what you please; infuse it in good *spirit of salt*; set it in sand, and give it fire enough to boil, and the oil, as well as the phlegm, will distil over into the receiver; you may separate this as has been directed; the spirit you are to pour off; rectify it, and you may use it again for the like process.

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* This process is needlessly laborious, and may be shortened by the methods mentioned in the several parts of the work: see the *purification of pot-ash, &c.* in the article "*Glass.*" *Ed.*

A curious Secret to distil Herbs, so that the Water will retain both their Colour and Taste.

TAKE the leaves of the herb you design to distil, and infuse them for a night and day in rain-water; then take a bolt-head, pour into it some of the water from off the herbs, and swing or rince it about; pour it through the pipe on the herbs again; fling more fresh leaves upon it; put on the head, and lute it close, and distil it in a sand-bath with a slow fire; you will see the drops will have the colour of the herb or flower. When you have distilled it all over into the receiver, then burn the leaves or ashes, and extract the salt from it in the manner above directed: put half of it into the distilled water; let it dissolve in the sun, and the colour will be clear and fine.

To make Vinegar of Wine.

FLING pieces of barley-bread into a cask of wine, and in two or three days it will be sour. *Or,*

Take rye-flour, and mix it into a dough with strong white-wine vinegar; then bake it in an oven, and beat it to powder; mix it again into a dough; bake it, and repeat it the third time; put these cakes in wine, and it will instantly begin to grow sour. *Or,*

Soak the best tartar nine or ten days in good vinegar, and then dry it in the sun; when dry, soak it again for ten days in vinegar, and, being dried, beat it to a fine powder: of this take as much as will lie on the point of a knife, and mix with a quart of wine, and it will, in a little while, turn it to vinegar. *Or,*

Take one pound of raisins, and clear them from the stalks, and put them into a glazed pan or pot, in a quart of good vinegar; let them soak over-night on hot ashes; boil them in the morning a little; then take it off the fire, and let it stand and cool of itself; strain it, and keep it for use. *Or*,

Take iron, or steel, and quench it five or six times in vinegar, and it will become very sharp. *Or*,

Salt, pepper and leaven put together into wine, and stirred about, will soon turn it into vinegar.

PART IX.

SEVERAL

SECRETS RELATING TO MARBLE.

Artificial Marble.

MARBLE is often imitated, and very closely, by powdering white marble, and by mixing it up with portions of plaster of Paris and water, after the materials have been finely sifted. Of this composition, called stucco, are made statues, busts, basso relievo's and other ornaments of architecture.

There is another kind of marble made of the flaky selenite, or a transparent substance resembling plaster, which becomes very hard, and receives so good a polish as to deceive the eye. This kind of selenite resembles Muscovy talc.

Stained Marble.

THERE is also an artificial marble formed by staining white marble with corrosive tinctures, which, penetrating to the depth of a line, or more, imitate the various colours of dearer marbles. This, however, requires some manual dexterity, and judgment, for if the marble be not well polished, and its pores previously opened, the effect will not be produced. Very hard white marble is to be chosen for this purpose, to which a due polish must be given, so as to leave neither spot nor vein. Heat is then to be applied to open the pores of the marble: in this lies the chief difficulty of the art. If the marble be made red-hot, the texture of it is injured; and, again, if the proper degree of heat be not given, the colours will not strike deep enough, nor be permanently fixed. A good general rule is, to heat the marble to that degree as to make drops of water boil on the surface, without making the marble red-hot. Different colouring drugs require different menstruums for their application, such as a lixivium of horse's or dog's urine, with four parts of lime and one of pot-ash: common lye of wood-ashes is very good for others: for some, spirits of wine is necessary; and, lastly, for many others, oily liquors, and common white-wine are required.

The colours which succeed best with certain menstruums are these: stone-blue dissolved in six times the quantity of spirit of wine, or of the lixivium of urine, and that colour which is called *litmus*, dissolved in common lye of wood-ashes. An extract of saffron, and painter's *sap-green*, both succeed well when dissolved in urine and quick-lime; and tolerably well when dissolved in spirit of wine. Vermilion, and a very fine powder of cochineal, also succeed well in the above liquors. Dragon's blood succeeds in spirit of wine, as does a tincture of logwood in the same spirit. Alkanet-root gives a fine colour; but the only menstruum to be used for it is spirit of turpentine; for neither spirit of wine, nor any lixivium will do with it. There is another kind of dragon's blood, called *dragon's blood in tears*, which gives a very elegant red colour when mixed with urine. What have been just mentioned are *mixtures*, but substances of some kinds have been used by themselves, and sink permanently into the marble whilst it is hot—viz. the purest kind of dragon's blood, for a red; gamboge, for a yellow; green wax, for a green; common sulphur, pitch and turpentine, for a brown. A fine gold-colour is given in the following manner: take crude sal-ammoniac, white vitriol and verdigrise, finely powdered, and intimately mixed together.

A more expeditious Process.

A GOOD method of operating in a small way, and in a rapid manner, is to put some spirit of wine into a silver spoon, and dissolve in it, over a charcoal fire, such colouring drugs as belong to that menstruum; then, dipping a camel's-hair pencil into the tincture, trace out upon the *cold marble* such veins and turns as accord with nature; after this operation, place the marble in a hot baker's oven, and it will come out penetrated with the colours. White veins may be traced upon the marble with ordinary white, and the interstices may be dabbed over with the tincture of that colour which you would have for the general ground-work; by this plan, the white paint may be removed, after the baking is performed; and the veins will be clear, and distinct at their edges, without the colours being intermixed with each other. Every degree of red may be given to marble, for a ground-work, by dragon's blood alone; thus, a slight tincture of it, applied without heat, gives only a pale flesh-colour; a stronger tincture, applied as before, gives a stronger shade of flesh-colour; heat being now applied to either, or both, the above tinctures, will heighten the red of both, in equal proportions; and the addition of a little pitch to the tincture, whilst in the spoon, will give it a tendency to a black colour, according to the quantity that is mixed.

How to prepare two Colours, of Gold and Silver, to stain Marble that is White, and Paint upon it: which will penetrate into the Stone, so as to bear polishing.

TAKE of aqua-fortis two ounces, sal-ammoniac one ounce, of highly rectified spirit of wine four drachms: then take some gold-leaf and make it into an amalgam with quicksilver; let the mercury evaporate, and the gold will remain at the bottom of your crucible, like a brown powder; dissolve this in aqua-regia, and evaporate it till it is of a yellow colour; then pour on the sal-ammoniac and spirit of wine, and when dissolved, evaporate the spirit again, and there remains a bright gold colour.

Calcine the silver in a phial, and then let the aqua-fortis evaporate until you have a sky colour, which take off and preserve in a clean phial, keeping the rest in a warm sand to evaporate, and you will have a deep blue, which also preserve; the remains will, by more evaporating, turn into black.

By mixing these colours you may produce several others, wherewith you may paint or stain what figures you please; and the more you repeat laying on this colour, the deeper they will penetrate into the stone, and the stronger they will represent themselves thereon. After you have finished your staining, you may polish it like plain white marble, and then you will have the colours appear in their full lustre.

To imitate Marble.

TAKE plaster of Paris, quick-lime, salt, ox-blood, stones of different colours, also pieces of glass, all beat to powder, and mixed up to the consistence of a paste, with vinegar, beer, or sour milk, and then lay it into tables, pillars, or what you will; let it stand until it is thoroughly dry; then rub it with a pumice, and polish it with tripoli, giving it the finishing stroke by rubbing it over with leather and oil. *Or,*

With finely pulverized plaster of Paris, and size of parchment, make a paste; mix with it as many colours as you please; spread it with a trowel over a board, and when dry proceed as before.

To paint on Wood in Imitation of Marble.

FIRST lay a ground, (repeating it seven or eight times) with white; then marble it with what colours you please, after you have tempered them with the white of eggs, and mixed a little saffron water therewith. If you are not used to marbling with a pencil, you may pour one sort of colour, here and there a little, upon the white prepared table, then, holding and turning it shelving, the colour will disperse all over the ground, in a variety of veins; then, with another colour, proceed in the same manner; and so, with as many as you think proper: after it is dry, you may, with a pencil, give it a finishing, by mending such places as are faulty; then you may lay on a varnish, and polish it in the best manner you can.

To imitate and counterfeit Agate.

Take of clarified turpentine as much as you will; boil it in an earthen pan, with a little sweet oil, till the turpentine is as thick as a dough; then pour it on a mould, and let it stand in the sun for eight days; after this you may form it into what shape you please, and set it in the shade till it is quite hard and dry.

Others take the whites of eighteen eggs, beat well together; then they add to it three ounces of clear gum-arabic, one ounce of almond-tree gum, beat to a fine powder, and mixed with the whites of eggs; when it is well dissolved, they pour it into an earthen plate or dish, and set it in the sun, till it is a mass of substance that may form or make impressions of any thing.

Others take the white of eggs, and beat them clear, and take off the scum with a clean spunge; then they colour it with a tincture of saffron, and pour it into a hog's bladder, and boil it hard on a slow fire, hanging the bladder in the air afterwards; when it hardens, so that you may form what you will; set it in the shade and it will have the hardness of a stone.

To imitate Jasper

Take quick-lime; mix it with the white of eggs, and roll it up in balls; (this will serve for the white:) for red, mix along with it, lake or vermilion; for blue, add indigo or Prussian-blue: for green, use verdigrise.

When you have made many different sorts of coloured balls, of the consistence of a dough, then flat them with a rolling-pin, as you would do pie-crust; lay them one upon another, and with a thin knife-blade, cut it in long pieces, and mix them confusedly in a mortar together;

then, with a trowel, spread it over a table, pilasters, &c. very smooth and even: when dry, pour boiling hot oil upon it, and, spreading it all over, it will soak in; then set it in a shady place to dry.

You may, if you will, mix your quick-lime and your colours with drying oil at first, and then there will be no occasion to oil it afterwards.

How to clean Alabaster, or White Marble.

BEAT pumice stones to an impalpable powder, and mix up with verjuice; let it stand for two hours; then dip into it a spunge, and rub the marble or alabaster, wash it with a linen cloth and fresh water, and dry it with clean linen rags.

To stain Alabaster-Images of all Sorts of Colours.

TAKE quick-lime, alum, sal-ammoniac, of each one pound, pour upon it, after you have pounded and mixt it, of stale urine of a boy one pound, and spirit of wine one pound; put it into an alembic; and the spirit of wine and urine will distil from it without fire; but, when you perceive that it comes low, put a slow fire under it, to distil the rest. When done, put it up in a phial and stop it close. This spirit extracts from all the drugs their natural colour, as out of Brasil-wood a fine red; out of Orleans a fine yellow; out of turnsol a purple; out of cochineal a fine crimson; out of litmus a fine blue; out of verdigrise a green; out of turmeric an orange colour, &c.

To imitate Marble, in Sulphur.

To do this, you must provide yourself with a flat and smooth piece of marble, on which make a border or wall, to encompass either a square or oval table, which you may do either with wax or clay. When this is done, provide, and have in readiness several sorts of colours, each separately reduced to a fine powder; as for example; white lead, vermilion, lake, orpiment, masticot, smalt, Prussian blue, and such like colours. After you are provided with them, melt, on a slow fire, in several glazed pipkins, some sulphur; put, in each, one particular sort of colour, and stir it well together; then, having before oiled the marble all over within the border, drop with one colour, quickly, spots upon it, of larger and less sizes; then take another colour, and do as before; and so on, till the stone is covered with spots of all the colours you design to use: then you must conclude what colour the mass or ground of your table is to be; if you would have it of a grey colour, then take fine sifted ashes, and mix it up with melted sulphur; or of red, with English red ochre; if white, with white lead; if black, with lamp black, or ivory black. Your sulphur for the ground must be pretty hot, so that the drops upon the stone may unite and incorporate together; when you have poured your ground even all over, then, if you will, put a thin wainscot board upon it; this must be done whilst the sulphur is hot, making also the board hot, which must be thoroughly dry, in order to cause the sulphur to stick the better to it; and when it is cold, polish it with oil and a cloth, and it will look very beautiful.

To imitate Prophyry, on a Glass.

TAKE red ochre and lake; grind them in a solution of gum-tragacanth; then sprinkle, with a brush or feather, the glass all over with that colour; when dry take brown-red, or if that is too red, add some umber, or soot to it; mix it up with the gum-tragacanth to the consistence of a paste, and lay it on the glass, over the sprinkled colours, as thick as you please; then let it dry. If you proceed after the same manner on a polished marble, or any other stone that is flat and smooth, and lay a thick coat of the brown-red on the spots of lake, letting it dry in the shade, and then polish it, you will have a beautiful imitation of prophyry, without the glass. Observe to anoint the stone first with a little oil, before you sprinkle your lake, so as to make it come off easy when the work is done.

How to make Fret-work Ceilings.

TAKE pebbles; pound them fine in an iron mortar; sift them through a fine hair sieve; then take of powdered lime one part, of the pebble powder two parts, and mix them together with water; then take the mixture, and lay it all over the ceiling very smooth; carve on it what you please, or lay to it ornamented moulds cut in smooth wood, or cast in lead; fill the mould with the mixture, press it to the ceiling, and it will stick and come clean out of the mould; let it dry; when dry, and you perceive that it is not every where of a good white, then, with a clean pencil-brush and clear water, strike it over, and it whitens of itself. It will in time grow as hard as stone.

MOSAIC-WORK:

How to perform it skilfully.

UNDER the name of mosaic-work are included such performances as relate to inlaid work; as tablatures of stone, wood, metals, &c. What I am now treating upon is that which represents not only all manner of figures, in their proper colours, attitudes and shapes, as large as those that are lasting ornaments in churches, and other public edifices, but also in small, and fit to grace the cabinets of the great and curious, and imitate a picture painted in miniature.

The antients, who practised this art with much skill and exactness, have [illegible] a variety of their performances, which are found not only in Italy, Spain, &c. but also here in England. Those remaining at Rome are the finest, in the Temple of Bacchus, now that of St. Agnes; and there are also curious pieces to be seen at Venice, Pisa, Florence, and other places.

The modern artists have improved very much in this performance, and whatever traveller has been at St. Peter's and the palace of Borghese at Rome, St. Mark's at Venice, and the church of St. Felicia at Florence, will confess they have seen wonders.

Such figures are composed, joined and cemented together of various coloured stones; but since nature has scarcely, at least not sufficiently, supplied the proper shades requisite for a masterly performance, that defect has been made up by counterfeiting those colours, by art, in glass; which is done in the following manner:

The glass materials are put in the crucibles or melting pots, and being in fusion, such a colour is added as you would make your shades with, in the manner you have been before directed, in the art of making artificial gems; beginning with the lightest. Having mixed it well, and taken out the quantity you think proper with an iron ladle, put it on a smooth marble, flatting it with another to a proper thickness; then cut it quickly into small pieces, laying them, when cold, in a box for use: add more colour, and proceed as before, repeating it till you come to the deepest shade. If you would gild them, wet them on one side with gum-water, and lay leaf gold upon them; and in an iron shovel, covered with pieces of other glass, heat them red hot in the mouth of a furnace; then take them out, and when cold, the gold will be so fixed and firm that nothing can hurt it.

When you begin to work, lay a thick ground against the ceiling or wall, with plaster, and having your design ready drawn and painted on blue or brown paper, clap part of it upon the wet plaster, and with a pair of small plyers, take up the small stones, and press them in their proper places; forming the figures and shades in their respective colours, as you are directed by your painted model. In this manner is done the history of "*Our Saviour's walking with Peter on the sea*," in St. Peter's church at Rome.

PART X.

PLAIN INSTRUCTIONS FOR PAINTING IN WATER-COLOURS; AND AN INTRODUCTION TO THE ART OF DRAWING IN PERSPECTIVE.

Of the Colours generally used in the Art.

- White
  - White Lead
  - Flake White
  - Muscle-shell silver
- Blue
  - Indigo
  - Smalt
  - Ultramarine
  - Litmus
  - Prussian Blue
- Red
  - Vermilion
  - Red-Lead
  - Red Ockre
  - Lake
  - Carmine
- Green
  - Sap Green
  - Verdigrise
  - Terra Vert
- Yellow
  - ~~Yellow~~ Ochre
  - Masticot
  - Dutch Pink
  - Gamboge
  - Naples Yellow
  - Shell Gold
- Brown
  - Brown Ochre
  - Wood-Soot, or Bister
  - Cologne Earth
  - Umber
- Black
  - Lamp Black
  - Ivory Black
  - Sea-Coal Black
  - Indian Ink.

Out of these colours you may form all the rest which your work may require.

Some colours are to be washed and ground; as, for instance, white lead; brown ochre; Dutch pink; umber; Cologne earth; ivory black.

Some are only to be washed, which are, red-lead, masticot, smalt, ultramarine, and vermilion.

Others are only steeped in fair water; as, gamboge, sap-green, and litmus.

And others again are only ground, viz. flake-white, indigo, lake, and verdigrise.

Grind all your colours with fair water on a hard stone, or on a piece of looking-glass, fixed with white pitch and resin upon a flat board, having also a muller of glass.

Of the colours, (after you have ground them very fine) you may take as much as will serve your present occasion, and temper them in a gallipot, or shell, with gum-water; in which you have also dissolved some sugar-candy. You must observe, that colours which are very dry, require a stronger gum-water; in others, it must be used very sparingly.

If your colours wont stick, or the paper or print be greasy, mix a very little ear-wax, or a little drop of fish or ox-gall amongst your colour; you may dry your fish or ox-gall, and dilute it when you have occasion for it, with a little brandy. If your paper or paint sinks, then with clean size and a spunge wipe it over, after you have fastened the edges round upon a board, and let it dry.

You should be provided with phials containing the following liquids, which are very necessary and useful in painting or colouring with water-colours; viz.

1. A phial with water in which alum has been dissolved. This you use in wiping over your table, parchment, or paper, before you begin to lay on your colours; it will cause them to lie smooth, and with a greater lustre.

2. A phial with lime-water. Dissolve or slacken some quick-lime in fair water; then take the water from off the settled lime, and put it up for use: this is of great use in tempering of sap-green and litmus, which colours, being apt to turn yellow, are preserved by this means.

3. A phial with gum-water; made of gum-arabic dissolved in fair water: if you add a little white sugar-candy to it, it will keep the colours from cracking and flying off the parchment or paper.

4. A phial with ox-gall, or the galls of eels, boiled up in a little water, and scum'd; this is of great use in painting of water-colours, where the parchment or paper happens to be greasy, by touching the point of your pencil to wet it, and to temper it with your colour.

5. A phial with white-wine vinegar: this is of use in grinding of distilled verdigrise, preserving that colour from changing upon the yellow.

6. A phial of spirits of hartshorn, a little drop of which mixt among the carmine adds to its beauty.

You must get pencils of several sizes, agreeable to the work they are for; as, for laying on a ground, sky or clouds, get a larger size than for drapery, trees, &c. The hair-pencils which, after you have wetted them between your lips, and turned them upon your hand, keep close together, are the best.

To paint or colour a clear Sky.

Take clear blue verditer, mixed with a little white; with this begin at the top of your landscape or picture, and, having laid on the blue for some space, break it with a little lake or purple, working, with a clean pencil, one colour imperceptibly into another; apply more white and masticot, in order to make it fainter and fainter towards the horizon, working, all the while, the colours imperceptibly one into another, from the horizon to the blue sky; after which you may lay some stronger strokes of purple over the light, so as to make them appear like clouds at a distance.

For a fiery red sky, use red lead and a little white, instead of the purple streaks or clouds, working them, according to art, imperceptibly one into another.

Clouds you are to lay on with white, and black, sometimes a little purple; but the best and surest direction you can have is from nature herself.

To lay a Ground on the Walls of Chambers, Halls, &c.

You must use, for a common wall, which is of a reddish hue, brown, red, and white, and temper your colour according as it is old or new; shade it with brown-red, mixed with a little bister or soot.

Other walls lay on with black and white, and shade with the same colours; sometimes mix a little purple with it, and then shade it with black and lake.

For wainscoting that is embellished with carved mouldings and figures, you must use one colour for both plain and carved work, shading and heightening it with judgment and care.

To paint a fore-ground in imitation of sand or clay, lay on the darker parts with brown ochre; to the distance, add a little white, and so on in proportion, shading it with brown ochre, and the strong shades with soot.

Of Carnation or Flesh-colour.

In a carnation or flesh-colour, use, for young women and children, flake white, burnt ochre, and a little vermilion: some add a little lake, but that must be but sparingly: having laid on the colour for the carnation, shade the lips, cheeks, chin, knees, and toes, with fine lake and vermilion, and the naked parts, with sea-coal and a little lake, or brown-red, or with brown ochre and lake, or with Indian ink, or lake: for a brownish complexion, mix a little brown ochre among the carnation colour.

Some artists lay the dead colouring of the carnation for young women with white, then shade it with *paper-black*, and bring in the carnation colour where it is required. Thus

Paper-black,

Is made in the following manner: take the paper in which leaves of gold have lain; burn them quick, one after another, and let them drop into a bason of clean water; then take them out, and grind them on a stone to a fine paste; form it into little tents, and let it dry; when you use it, temper it with gum-water as you see fit.

For old people, use vermilion, brown-ochre and white, shade it with bister and lake.

A dead corpse of a young person paint with flake-white, brown-ochre and a little indigo, or sea-coal; and shade it with bister, or sea-coal.

For an old dead corpse, leave out the indigo, but shade it as before.

For dead bones, take white-lead mixed with a little bister or chimney soot; with which shade it, and heighten it with white lead.

For the hair of young women and children, lay them with light ochre, shade them with deep ochre, and heighten them with masticot and white.

Grey hairs lay on with black and white; shade them with black, and heighten them with white; and thus proceed in painting any other coloured hair.

Drops of blood lay on with red lead; shade it behind, where light falls, with carmine and lake.

Trees are laid on, some with white, black, and bister, shaded with brown ochre, and heightened with the same colour, with more white in it. Those that stand at a distance are laid on with indigo-blue, brown-ochre, and white, and shaded with indigo and brown-ochre. Those that are further distant, lay on faint, and shadow them but slightly; which order you must observe in colouring of ships, houses, and other buildings.

In thatched houses, paint the thatch of straw, when new, with Dutch pink, and shade it with brown-ochre; and to heighten the straw, use masticot and white. Old straw lay on with brown-ochre, sometimes mixed with black and white; heighten the straw with brown-ochre, and white.

In colouring cities, castles, or ruins, you must observe nature, for no rules can be well given; however, to give a little light to a young practitioner, it must be observed that those houses which lie nearest the fore-ground are coloured with vermilion, white, and a little brown-ochre; shading with that and some bister; the heightenings are done with vermilion and white.

Houses further distant are laid on with lake, and a little blue and white, shaded with blue and lake, and heightened with adding more white.

Such buildings as are still further, lay on with a faint purple and a little blue, shaded softly with blue, and heightened with white; and the further they are off, the fainter and slighter must be your colour.

Flames and smoke are laid on with a pale yellow; shade the smoke with paper-black, or soot; the flames shade with red-lead or vermilion, and heighten them with Naples yellow.

In colouring of rocks, hills, &c. that are at a great distance, observe the same rule. Such as lie nearer the fore-ground you are to imitate according to nature. Trees that are upon the fore-ground, you paint with several sorts of greens, the better to distinguish one from the other;

such as are on distant hills, must be done with the same colour as the hills.

How to paint or colour Cattle.

HORSES of chesnut colour you are to lay on with brown-red, shaded with brown, red, and black, and heightened with brown, red, white and yellow; the manes and tails of horses you may make white, as also the lower part of their feet.

You are to lay one of an ash-colour on with black and white; shade it with a bluish black, and heighten it with white.

Lay on a black horse with all black; shade it with a deep black, and heighten it with black and white.

Lay a white horse on with white-lead, just tinted or broke with a little red; shade it with black and white, and heighten it with pure white.

Spotted horses must be done according as nature directs; and by these directions you will govern yourself in painting or colouring any other sort of cattle.

Lay sheep on with white, broke with a little bister; use in the shadows a little black.

Lay on hogs or pigs with brown ochre and yellow ochre, and shade it with bister.

A bear is laid on with brown ochre, black and brown red, shaded with bister and black; and heightened with brown ochre and white.

A leopard is laid on with yellow ochre, and shaded with bister; the spots are laid on with bister and black; the mouth with black and white.

An ass is commonly of a grizly colour, and laid on with black and white, broke with a little ochre.

An elephant is laid on with black and white and a little bister.

A monkey is laid on with Dutch pink, bister and black; the hair is heightened with masticot, white, and a little bister; the paws must be shaded off with black and brown-red, with a little white.

A hart is laid on with brown ochre and English red, and shaded on the back; and, where it is requisite, with bister and brown-red: a streak of white must be below the neck and the belly and breast of a white colour.

A hare is laid on with brown-ochre, which loses itself by degrees into white under the belly; the back is shaded with bister, and the hair is heightened with ochre and white.

A rabbit is laid on with white, black, and bister; the belly is white: these creatures are of various colours, which may be imitated after nature.

Of Birds.

A FALCON is laid on with brown ochre, black and white, shaded with a pale black; the feathers must be displayed and shaded with black; the breast is white, the legs yellow, and shaded with brown-ochre and bister.

A turkey-cock or hen, is laid on with black and white, and shaded with black, working the colours lighter and lighter towards the belly, which must be all white; the legs are laid on with indigo and white, and shaded with blue; when they are irritated, the substance about their bill must be laid on with vermilion and lake, deepening it with stronger lake; otherwise, when they are calm, that part is a little upon the purple.

A swan is laid on with white, with a little bister, and heightened, where the feathers seem to rise, with pure white; the feet are blackish, and the bill red, with a black rising at the upper end.

Pigeons, drakes, hens, &c. are of so many various colours, that there would be no end to give proper lessons for every one: and thus it is with many other birds, which an artist ought to copy after nature.

Of Fruit.

APPLES are laid on with fine masticot mixed with a little verdigrise; or a little white French-berry yellow, and verdigrise; shade it with brown-ochre and verdigrise, or lake; heighten it with masticot and white, and the strongest light with white alone; but you must regulate yourself according to the colour of the apples; so also pears.

Cherries are laid on with vermilion and lake, shaded with pure lake, and heightened with vermilion, or vermilion and a little white.

White-heart cherries are laid on in the middle with vermilion, lake and white; working it to a yellow towards the stalk, and with lake towards the top.

Morello's are laid on with lake and a little black, shadowed with black, and heightened with vermilion, lake and black: this must be intermixed, that the colours may seem all of one piece.

Mulberries are laid on with lake and bister, shadowed with black, and heightened with vermilion; on the highest lights give little dots with lake and white.

Strawberries are laid on with a yellowish white, then shaded with lake and vermilion; heighten the knobs with white and vermilion.

Grapes; the black ones are laid on with purple, shaded with blue verditer and indigo, heightened with white.

White grapes are laid on with pale verdigrise, a little masticot, and white; the blue bloom is very gently, with a blunt pencil, touched with blue verditer.

Peaches and apricots are laid on with white masticot, or French-berry yellow and white, shaded with red-ochre and yellow; if there be a bloom upon them, do it with lake, and heighten it with white as you do the grapes; some are of a greener colour than others, wherein you are to copy nature as it lies before you.

Radishes and turnips are laid on with white, shaded with Indian-ink, and at the top with lake; working it down faint into white towards the bottom. The top is laid on with verdigrise and sap-green, shaded with sap-green and indigo, and heightened with masticot.

Carrots are laid on with yellow-ochre, and, if they are of a high colour, it is mixed with red-lead; they are shaded with brown-ochre, yellow-ochre and bister, and heightened with masticot. For the rest, let the practitioner follow nature.

Of Flowers.

ROSES are laid on with a pale carmine and white, shadowed with carmine and less white, and the deepest with carmine by itself; make the heart always darker than the rest. The seed in full blown roses is yellow.

Tulips are of various kinds, colours, and shapes; it is impossible to give certain rules for colouring them.

Some are done with lake and carmine on white, mixed together; others with purple, laid on with ultramarine, carmine and lake; sometimes bluer and sometimes redder: these colours must be streaked according to nature. Those of one colour, as yellow, red, &c. are laid on with such colours; and, if there appear any streaks, you must make your colour either lighter or darker, as nature directs.

Anemonies are of several sorts; some are laid on with lake and white, and finished with the same: others with vermilion, and shadowed with that colour, carmine, and lake. Yellow ones are laid on with masticot, shadowed with that and vermilion; sometimes with brown-red.

Red lilies are laid on with red-lead, shaded with vermilion, and carmine.

The peony is laid on with lake and white, and shaded with the same colour, and less white.

Yellow cowslips are laid on with masticot, and shaded with gamboge and umber. Purple ones are laid on with ultramarine, carmine and white, and shaded with less white.

Carnations and pinks are managed like anemonies and tulips.

Some pinks are of a pale flesh-colour, streaked with another that is a little higher; this is done with vermilion, lake and white, and streaked without white.

The blue hyacinth is laid on with ultramarine and white, and shaded with less white.

The red hyacinth or grideline, is laid on with lake and white, and a little ultramarine; and finished with less white.

The white sort is laid on with white, and shadowed with black and white.

Crocuses are of two sorts, viz. yellow and purple. The yellow is laid on with macticot, and shaded with gall-stone or gamboge; after which, upon each leaf on the outside, are made three separate streaks with bister and lake. The purple ones are laid on with carmine, ultramarine and white, and finished with less white; the streaks must be very dark on the outside of the leaves. The seed of both is yellow.

Of Metals.

Gold is laid on with red-lead, saffron, and yellow ochre, shadowed with lake and bister; in the deepest places with bister, lake, and black; then heightened with shell-gold.

Silver is laid on with white, shadowed with black and blue, and heightened with shell-silver.

Tin or pewter is done the same way, only it is laid on with white, mixt with a little indigo.

Iron is done like tin.

Brass is done in the same manner as gold, only the shades must not be so strong.

Copper is laid on with brown-red and white, shadowed with brown-red, lake, and bister, heightened with brown-red and white.

These directions will be sufficient to guide young practitioners to nature, which is the best school they can go to.

A SHORT INTRODUCTION TO THE ART OF DRAWING IN PERSPECTIVE.

Perspective is the art of drawing on a plane, or flat surface, the real resemblances of such objects as are seen by the eye from any distance or situation.

To understand the ground-work and principles of this art, it will be proper to consider the object that is viewed, as if seen through a transparent window, interposed between it and the eye. Suppose, for instance, a person at a window looks through an upright pane of glass at an object beyond it, and draws the object steadily upon the glass, as if the point of the pencil touched the very object itself; if he were to cut out the glass afterwards, and lay it flat upon a table, it will represent the object he has seen and drawn, just as it ought to appear upon a sheet of white paper, without having first drawn it upon the upright pane of the window.

This art, therefore, furnishes the rules whereby every object may be delineated on a flat surface, with equal truth and certainty as if we could carry such an upright pane, or window, with us wherever we had occasion.

By proper attention to the few following rules, a more extended notion of the powers of perspective may be gained, previous to a fuller knowledge of the study, to which this professes only to be an introduction*.

To raise a perpendicular Line.

Draw a line, which, with your compass, divide at A, fig. 2, then from the ends of this line C D. make the arches, which divide themselves in B; then draw a line from A to B. If the perpendicular is to reach below the line given, you proceed in the same manner as above the line. *See plate* 7.

To divide a given Line into any Number of equal Parts.

Let A B, fig. 3. plate 7, be the given line. From the point A draw a right line A K, at pleasure; from the point B draw a right line B P parallel to A K; set off along A K and B P, from the points A and B, as many equal parts A E, E F, F G, &c. and BK, KL, LM, MN, &c. towards K and P respectively, as are one less than the number into which you intend the given line to be divided: join the last point in A K, with the first in B P, and also join the other points I K, G N, F O, &c. and the right lines K K, I L, H M, G N, &c. will divide A B into the desired number of equal parts at the points, *k*, *i*, *h*, *g*, &c.

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* Many excellent treatises have been written on the subject of *perspective*, but the one which gives the most valuable and varied examples, though it be unjustly neglected and overlooked, is printed in *quarto*, by *D. Fournier*, an ingenious foreigner, who acted the several parts of poet, painter, cook, machinist, and fiddler, within the city of Westminster.

To draw a parallel, as Q R, parallel to O P, fig. 4, you must draw equal semi-circles, and make the line Q R, touch their extremities. *See plate* 7.

The horizontal line is no other than a parallel to the base.

The diagonal line is drawn from one angle to another, as S T, fig. 5. pl. 7.

An equilateral triangle is raised upon a given right line A B, by setting the compasses at C; and at the distance D describing the arch E D; also from D, at the distance C, describing the arch E C, and drawing right lines from E, to C and D respectively; raising the triangle C D E, fig. 6. pl. 7.

Ichnography is the dimension of a platform or plane, upon which any thing is to be raised, as A B C D is the ichnography or plane of a square body. See fig. 7. pl. 7.

Orthography describes or represents the face or fore part of the object, as of a building, or a body of any thing opposite to one's eye, so as E F G H, which is the orthography of the fore part or front of a cube, or a building, fig. 8. pl. 7.

Scenography represents the object wholly elevated, with all its dimensions of the front, sides and top which may be seen; as I K L M N O P is a perfect cube. See fig. 9. pl. 7.

Of the visual Rays.

THE visual ray is that from the object to the centre of the eye; it is the strongest of all others; it divides the horizontal line and gives the point of sight. If the object be a point, then there is but one visual ray, which is called central, *a b*, fig. 1. pl. 8. If the object be a right line, as *a b*, fig. 2, the visual rays make a triangle, whereof the line *a b* is the base, and the two lines, *c d*, the rays on the outside, which come from the eye *e*, and make the triangle *e, a, b*. If the object is a square superficies, the visual rays will make a pyramid, as fig. 3, of which *a* is the central and strongest.

Of the Horizon.

The horizon, in perspective, is a line which gives the height of our eye, and bears always the points of sight and distance; or rather, a line which separates the heaven from the earth, and which limits the sight; for one cannot see any thing above the horizon which does not surpass the height of the eye: thus a tree or mountain may have its top above the horizon, but the foot of it is a good deal below it; as, for example, A B, fig. 4, are two pillars below the horizon C, because the eye is elevated. In fig. 5. they are even with the horizon C, because the eye is with them at an equal height: in fig. 6. they are much above the horizon C, because the eye is lower. Thus, according to different stations of taking the horizon, the subject before us will be either higher or lower than the horizontal line. *See plate 3.*

Of the Point of Sight, the Base, the Point of Distance, and the Point Accidental.

The point of sight A, is that which makes the central ray on the horizontal line, to which all the other visual rays, as D D, are to join themselves. See plate (10) fig. 1.

The base, or plane B B, is the line on which the objects stand; for every object has its own plane, which is always parallel to the horizontal line.

The points of distance C C, fig. 2, plate (10) are points set at an equal distance on each side of the point of sight A, and is always within the horizontal line, *a b*. A the point of sight; D D the visual rays; C C the points of distance; B B the plane or base; E E the abridgments of the square, of which D D are the sides; F F the diagonal lines, which go to the points of distance C C.

Points accidental are certain points where the objects end; these may be cast negligently, because they are not drawn to the points of sight, nor distance, but meet each other in the horizontal line; for example, two pieces of square timber, G and H, fig. 3, plate (10), make the points I I I I on the horizon, and go not to the point of sight K, nor to the point of distance C C: these accidental points serve likewise for casements, openings of doors, windows, tables, chairs, &c.

Of the Point Direct, or Front.

THIS is when the object is wholly before you, having neither one side nor the other in your view, but shewing only the fore part or front, when elevated; (if it be not a polygon).

The Oblique Point of Sight,

Is when the object is seen sideways, with the corner of the eye: while the eye is always opposite the point of sight, the visual rays, drawn as usual to that point, will make the object appear athwart.

Of the Diagonals and their Sections.

A GEOMETRICAL PLANE, where the lines are perpendicular and parallel to the base, are always, in perspective, to be drawn from the base to the point of sight; for instance: suppose one gives a shorter or longer line for the perspective than what is in the plane, as for instance, fig. 1. plate (11), the long line A B (which must have the same number of divisions as that of the plane C): from all which divisions you draw lines to the point of sight D. The diagonals F F are drawn for the dimensions of the squares; and wherever the diagonals cut the outer rays A D, B D, there is the abridgment of the square, as G G. Now, to place lines according to their true vanishing distances, only draw a line from each of the divisions on the base line (as in H. fig. 2.) to the point of distance E, and so successively from I to E, K to E, L to E, &c. and you have one side properly divided. The other side is divided in the same manner, beginning from O to E; next from N to E, and so on. *See plate* 11.

Deep sinking in drawing of Perspective.

This is done by means of drawing from each side of the base H H to the point of sight I, and likewise from the same sides to the point of distance K K, and where the latter divide the former, as in L L, that is the first abridgment: then drawing from L L to the points of distance, you will at M M find the second distance, and so on, see fig. 3 and 4, plate (11). If the abridgment is to be oblique, you mark the point of sight. Thus you may draw any plane or pavement, garden plats, &c. as for example, fig. 2, plate (11), you divide the base A B equal to the number of squares in the breadth of a pavement; then draw, from these divisions, the lines to the point of sight D; after which, draw the diagonal lines; and where they divide the lines to the point of sight, there draw lines parallel to the base.

Of Elevation in Perspective, or Scenography.

This is the art of bringing any thing elevated, to a true proportion, at the distance they are standing: for which purpose, you draw a line perpendicular to one side of the plane or base, on which you mark out the height of the first object, and from that height you draw a line to the point of sight, which you may place any where on the horizon; and whatever you draw perpendicular between them, will describe the true proportion each elevation is to have (if they are of an equal height); if any thing appears above the horizon, which interferes with those elevations of equal height, it must be drawn according to the measure of its height, as you will be directed.

Hence it follows, that when two triangles are joined together they will produce four; the two original ones will serve for top and bottom, and the two occasional ones, for the sides: for all the four together will close at the centre A, which is the point of sight where all the visual rays meet together; and according to the distance of the objects, those above the base, those below raise themselves, and those of the sides close themselves, as you see in fig. 1, plate (9).

The trees are produced by the same cause, and bring forth the same effect, where one triangle comprizes the air, another the earth, and the two side-ones the trees, as fig. 2, plate (9).

If the horizon be even with the elevation A, you draw a line from the foot of that elevation *a*, to the point of sight B; and all the figures which are at the distance must receive their proportionable height from the perpendicular C I drawn from the horizon, between the first figure and the visual ray or line of sight; see fig. 1, plate (12).

If the elevation be above the horizon, you proceed in this manner: having drawn the horizontal line, you mark thereon the point of sight F; suppose the first elevation E to be half its height above the horizon, or let it be a quarter; then you draw from the bottom and the top of that elevation to the point of sight F, and between these lines you draw perpendiculars for the elevation of the figures G H which are at some distance. See fig. 2, plate (12).

When the horizon is high, we must from the first figure I, fig. 3, plate (12), draw its height to any place of the horizon, which is here to the point K; all the heights of the other figures must be placed between the triangle K L M, which will determine their height at their respective distances, as is shewn in fig. 3, plate (12), at N N N, O O Q.

Figures that have their feet on the horizon are proportioned according to the height of the first or principal figure by drawing a line from the head, or a measure of its height, to any part of the horizon, the perpendiculars B C between both, will give the heights required. Painters or engravers ought to make the principal figure strongest, and the most finished. See fig. 1, plate (13).

Figures raised upon pedestals must have the same height as though they stood upon the plane, in which you proceed as in fig. 2, where A has the same height as B, and C is equal in height to D, and E is equal to that of F. See fig. 2, plate (13).

The same rule is to be observed in figures which stand lower than the base or plane, as you see in fig. 3, wher G is equal in height to H, and I to K.

The height of figures seen far beyond a hill, or any other eminence, are found by drawing the natural height of a man, horse, &c. from the foot of the mountain A. fig. 1, to the point of sight B; proceed as has been directed, observing that the figures C and D elevated on the hill and post must be of the same dimension and height with A, as must any other figure that stands upon an eminence on the same ground with the first figure. Supposing the hill to be twenty-five feet high; the first figure we will say is five feet, the second figure standing twenty feet high, reaches up to the top of the hill and meets the horizon. The figure on the hill being of the same height as the two former, has his feet upon the horizon. The little figures beyond the hill are drawn according to the perpendiculars, as *a* to *a*, *b* to *b*, and *c* to *c*.

Beasts are done by the same rule as men and other figures, as for example fig. 2, plate 14, having drawn the first horse A, and from his height to the point of sight, the perpendiculars will be marks for the proportion of those at a distance, as *b* to *b*, and *c* to *c*.

Birds flying in the air must be drawn from the ends of the wings of the first bird A, to the point of sight on the horizon, B; and the parallels, between the first bird and the point of sight, will give a due proportion to the rest, as *a* to *a* and *b* to *b*, fig. 2. plate (14). The same of horses, &c. see fig. 3.

If you draw chairs, tables, boxes, &c. in perspective, you must observe the rules of scenography. See fig. 9, plate 7. Doors, windows, window-shutters, &c. describe either a part, or the whole, of a semi-circle, according as their opening is more or less; which, from the plane of squares, you may easily bring into perspective by the same rules.

PART XI.

OF

COSMETICS, ODORIFEROUS-WATERS, OILS, &c.

How to beautify the Skin.

TAKE rye bran, sift it through a fine sieve, and repeat it till it is clear from all the flour; then soak it for three or four hours in white-wine vinegar; put in some yolks of eggs; stir it together, and distil it in *balneo mariæ*: the water thus drawn off is an excellent cleanser and beautifier of the skin.

Another.

TAKE parsley, nettle seed, peach-kernels, of each an equal quantity, boil them in fair water, with which wash your hands or face. *Or,*

Take lemons and hard boiled eggs, cut them in slices, and lay them one over the other in a still, the bottom of which you are first to cover with well-washed turpentine. The water that is distilled from it, preserve for use. *Or,* Boil the blossoms of rosemary, alum and tartar in wine, with which wash your hands and face. *Or*,

Take slices of lemons and dried beans; let them soak in wine; add some honey, eggs, and goat's milk; then distil it.

A fine Water for beautifying t [illegible]

TAKE a couple of calves feet, and boil them in eighteen quarts of river water, to half the quantity; then put in of rice and crumbs of fine bread steeped in milk, two pounds, fresh butter two pounds, and the white of ten new laid eggs; mix all together and distil; put into the distilled water a little camphor and alum, and you will have a fine beautifying wash.

An Odoriferous Water.

TAKE of fresh rosemary-flowers two pounds; amber one scruple; orange, lemon, and citron-water three pints, set these in a well closed glass vessel for ten days; then distil it in *balneo mariæ*, and keep the water for use. *Or*,

Take orange peel and green-lemon peel, of each half an ounce; cloves one scruple; fresh lavender blossoms six ounces; mix all these things together, with three quarts of damask rose-water, and let it stand covered up for some days; then distil it in *balneo mariæ*, and the water will be excellent.

To prepare the Cloth of the Levant, for Ladies to colour their Faces with.

TAKE shavings of scarlet cloth, and boil them for some time, in water wherein quick-lime has been dissolved; then strain it, and, to the quantity of a quart, put an ounce of roach alum, and the same weight of verdigrise, together with one quarter of an ounce of gum-arabic: having boiled it for the space of half an hour, take an old piece of linen cloth, of what size you please, and put it into the decoction, or red colour: cover the pan, and let the liquid cool for the space of a day; then take out the cloth you have dyed; dry it in the shade; and keep it in a box, among odoriferous and sweet-scented things, and use it when there is occasion.

To prepare Oil of Benjamin, or Benzoin.

TAKE an earthen pot that is high and narrow, with a little border round it; put into it three or four ounces of clean benjamin, grosly powdered; cover the pot with a pyramidal paper cover, and tie it round under the border; set the pot into hot ashes, and when the benjamin is heated the flowers will sublime; take off the cover every two hours, and fix another in its place; stop up, quickly, in a glass, the flowers you find in the covers; and when those which afterwards sublime, begin to appear yellow, take the pot off the fire, and let it cool. You will find a black and shining matter cleaving to the bottom of the pot, which is taken off with a warm spatula; it is light, easily broken, and of a strong smell, if it comes near the fire; pulverize the same, grosly, and put it into a retort of a sufficient bigness, and fill it only a third part; place it upon the sand; and, having fitted a receiver, lute the joints, and make a small fire underneath, in order to heat the retort, and distil an oil, part of which will become thick in the receiver: continue the small fire till nothing more distils; keep this red oil in a glass bottle; the odour is agreeable, and its taste sharp and pungent.

Oil of Roses.

TAKE the seeds of melons, well cleansed, and stamp them in a stone mortar; lay them in rows, or beds, together with rose-leaves, for the space of eight days; then take a little linen bag, wet it in rose-water, and put into it the melon seeds and rose-leaves: having tied it close, put it between a press, and press out the oil. This oil is very fine, and therefore carefully close it up in a phial.

Oil of Cloves.

TAKE sweet almonds, scrape and cleanse them with a knife, break them in pieces, and steep them in rose-water; stamp also cloves; temper and steep them likewise in rose-water, so long till it has extracted the virtue of the cloves; then put the almonds, cloves, and the waters of each together, and leave them till you find them swelled; then take them out; dry them in the sun; and put them again into the water to swell; repeat this five or six times: then put them into a press, and press out the oil; which keep in a phial, stopped close. In this manner you may make oil of musk, amber, cinnamon, mace, nutmegs.

Queen of Hungary's Water.

FILL a glass, or earthen cucurbit, half full of rosemary flowers, gathered when in their prime; infuse them in spirits of wine; set it in a water-bath; join it to its head, luting the junctures well; give a digesting fire for three days; after which, unlute them, and pour what has been distilled into the cucurbit; refit, and increase the fire strong enough to make the liquid distil, so as one drop may immediately follow another; when you have drawn two-thirds of it, and put out the fire, let the vessels cool, and unlute them, and you will find in the receiver a very good Hungary water; keep it in a phial well stopt; it is good in palpitations and swooning; in the palsy, lethargic and hysterical diseases; the dose is from one drachm to two. Outwardly it is used for inflammation, tumours, pains, palsy, and in reviving the spirits.

Ladies use it to beautify their complexion, by mixing half an ounce with six ounces of lily-water, or bean-flower-water; washing their faces with it.

To make Balls for taking out Spots of Oil or Grease.

TAKE soft soap, incorporate it with ashes of vines, finely sifted, of both an equal quantity: then add to it roach alum burnt, and tartar, well beat into powder, incorporate all together and form thereof little round balls, and lay them by for use when occasion requires to make use of them

To prepare a Leather Strap.

PROCURE a piece of leather, very smooth on the flesh side, and about two inches broad, glue it to a thin board of the same breadth; when dry, smear it all over with tallow candle, and then hold it a little over the fire, till the grease is penetrated through the pores of the leather: repeat this three times, and afterwards pour over it a little tripoli, washed clean, which, with the grease, work into the leather, so long till the grease becomes warm; then pour on fresh tripoli; repeating this operation four or five times, till the leather is fit for use. *Or,*

Take finely powdered emery; steep it in fair water, and pour a good deal more upon it, stirring it well together. Let it stand a while to settle; pour off the water, and put one end of a linen or woollen rag to the bottom of the settled emery; and let the other hang out, in order to draw off all the water from it, which being become dry rub it into the greasy leather, in the same manner as you did the tripoly; only work in the emery with a piece of smooth ivory, or with a burnisher; after this, stroke your razor softly over it, and the effect will be, that razors thrown aside as useless are so recov[illegible] as to be fit for shaving. Now, as one razor is softer [illegible] other, you must pass a soft one on a strap prepared [illegible] tripoly and a hard one upon a strap prepared with [illegible]

To make the Hair grow.

TAKE the tops of hemp, as soon as the plant begins to appear above ground, and infuse them in a small portion of water for twenty-four hours. Dip the teeth of your comb in the above, and it will quicken the growth of the hair.—Or, dip the teeth of your comb in the expressed juice of nettles, and repeat it frequently.

A Liniment, for the same Purpose.

TAKE six drachms of labdanum, two ounces of bear's grease, half an ounce of honey, three drachms of powdered southernwood, a drachm and a half of the ashes of the root of calamus aromaticus, three drachms of balsam of Peru, and a little oil of sweet almonds. Make a liniment.

A compound Oil, for the same.

TAKE half a pound of the leaves of green southernwood; boil them in a pint and a half of sweet oil, and half a pint of red wine: when sufficiently boiled, remove it from the fire, and strain off the liquor through a linen bag. Repeat this operation, with fresh southernwood to the strained liquor; and to the last strained liquor, add two ounces of bear's grease.

A Remedy for Corns.

Roast a clove of garlic, or a small onion: cut it open whilst hot, and apply it immediately to the corn. Soak the foot the next day in warm water; roast another clove of garlic, as before, and proceed thus daily till the corn is removed, which will seldom exceed a week. Some people have recommended a leaf of ivy which grows against walls to be steeped in vinegar and applied to the corn with a fillet over it, changing it daily, and soaking the foot at each operation.

An excellent Tooth-powder.

Take of the soft part of the cuttle-fish bone, and of the finest prepared chalk, each half an ounce; Peruvian bark, and Florentine orris root, each two drachms: reduce the whole into a fine powder, and mix them intimately, by sifting them through a drum-shaped lawn sieve. This may be coloured with a little rose-pink, and scented with a few drops of oil of cinnamon.

Another Dentifrice.

Take prepared pumice-stone, sealed earth, and red coral prepared, of each one ounce; dragon's-blood, half an ounce; cream of tartar, an ounce and a half; cinnamon a quarter of an ounce; and of cloves, a scruple: beat, powder, mix and sift them.

Imperial Water.

TAKE two quarts of the best proof spirits, and dissolve in it one ounce of frankincence, mastich, benjamin, and gum-arabic; and half an ounce of cloves and nutmegs; add an ounce and a half of pine-nut kernels (to be had at the seed-shops), and the same of sweet almonds; also, three grains of musk. Bruise the above articles in a marble mortar, and distil in a water-bath; and keep the water that is drawn off, in a bottle well stopped. This water removes wrinkles, and renders the skin uncommonly delicate; it also whitens the teeth, abates the tooth-ache, sweetens the breath, and strengthens the gums.—Foreign ladies set a high value upon it.

Venetian Water, to clear a Sun-burnt Complexion.

Take a pint of cow's milk, in May; a pint of water that distils from the vine when wounded, or the expressed juice of [illegible] tendrils bruised; eight lemons, and four Se-[illegible]s, cut in slices; two ounces of sugar candy; half an ounce of borax, in powder; and four narcissus roots, beaten to a paste. Mix the above ingredients, and distil in a vapour-bath. Re-distil, and keep it in a close vessel, for use.

To preserve Flowers.

TAKE the finest river sand, called drift-sand, free from all adhering earthy particles. Dry it well; and put a thin layer at the bottom of a dry earthen pan. Hold the flower you intend to preserve, upright, and carefully lay the sand around it, without disturbing the leaves or blossoms: set the pan in the sun, but free from rain and moisture, and your flower will be very little inferior to the fresh one. Thus you may preserve roses, all the year round. If you wish to keep tulips, cut out the triangular top which grows in the middle of the cup, previously.

A Liniment to destroy Vermin.

TAKE an ounce of vinegar, and an ounce of powdered staves-acre; half an ounce of honey, and half an ounce of flowers of sulphur. Make them into a liniment, with two ounces of salad-oil.

A fine Varnish for the Skin.

TAKE equal parts of lemon-juice, and whites of new laid eggs; beat them well together in a glazed earthen vessel. Put the pan on a slow fire, and keep stirring the mixture with a wooden spatula or stick, till it is thick as butter. Keep it for use. When you mean to use any, add a few drops, to the part you use, of any distilled water. Wash the face first very clean, and then apply the varnish.

A Remedy for Whitloes.

TAKE pellitory of the wall; cut it as small as possible, and mix it with hog's lard, in an equal proportion. Wrap it up in several papers, one over the other, and place it in warm wood-ashes, not hot enough to burn the paper, but sufficient to incorporate the inclosed materials. Apply this liniment, spread thick upon brown paper, to the whitloe, twice or thrice a day.

Fine perfumed Powder for the Hair.

TAKE a pound of Florentine orris-root, in fine pow[illegible] two ounces of powdered gum-benjamin and storax; yellow saunders a pound and a half; cloves, two dr[illegible] some powdered dried lemon-peel. [illegible] above, well powdered, and sift them through a lawn sieve, with twenty pounds of powdered starch, or common hair-powder.

Almond Paste, for the Skin.

BEAT any quantity you please, of sweet and bitter almonds, previously blanched, or deprived of their skins, in a marble mortar: while beating them, pour in a few drops of vinegar to keep them from turning oily. After the paste is formed, add of powdered storax two drachms, two ounces of whitish honey, and two yolks of hard boiled eggs. Make the whole into a paste.

Cold Cream, for the Complexion.

TAKE white wax and spermaceti, of each a drachm; oil of sweet almonds, two ounces; spring-water, an ounce and a half: melt the wax and spermaceti together in the oil of almonds, in a glazed earthen pipkin, over hot ashes, or in a water-bath. Pour the solution into a marble mortar, and stir it about (but not with any thing metallic) till it is cold and smooth; add the water gradually. By agitation, this pomade closely resembles cream, whence its name. Some add rose water, or orange-flower water, in preparing it; or a few drops of essence of lemons, &c. &c. It prevents the pits of small-pox from marking, and is an excellent article for the skin. Keep it in a gallipot, tied over with bladder, and leather.

Lip

Lip Salve.

Take three ounces of oil of almonds; three quarters of an ounce of spermaceti, and a quarter of an ounce of white wax; melt them together over a slow fire, mixing in a little powdered alkanet root. Stir it till it is cold, and add a few drops of oil of rhodium.

White Pomatum.

Take an ounce of Florentine orris-root; half an ounce of calamus aromaticus, and the same of gum-benjamin; a quarter of an ounce of rose-wood, and a quarter of an ounce of cloves. Bruise the whole into a gross-powder, tie it up in a linen bag, and simmer it in a water-bath with two pounds and a half of hog's lard well washed: add a couple of pippins pared and cut into small bits, four ounces of rose-water, and two ounces of orange-flower water. Simmer them together a few minutes longer; strain off, and stand by till cold; then tie it up close in a gallipot, for use.

A Pomatum to remove Wrinkles.

Take the juice of white garden lily-roots and fine honey, of each two ounces; melted white wax, one ounce; incorporate the whole, and make a pomatum. Apply it over night, and leave it on till the morning.

A Pomatum for the Skin.

Take oil of white poppy-seeds, four gills; spermaceti, three quarters of an ounce; white wax, an ounce; mix them into a pomatum, after the manner of the rest.

Method of scenting Pomatum.

SPREAD your pomatum about an inch thick upon several dishes or plates, strew the herbs or flowers whose scent you like upon each. Set one upon the other, changing the herbs or flowers every twelve hours. Scrape off the pomatum; gently melt the whole together in a large covered pan, set in a water-bath, and it is completed. Tie a bladder over it, in gallipots, and keep it for use.

Common scented Powder.

To every pound of common starch powder, add one ounce of Florentine orris-root, finely powdered, sifted, and blended.

For the Eyes.

TAKE white vitriol and bay salt, equal parts, viz. one ounce. Decrepitate them, *i. e.* dry them till they crack, in a pan, crucible, or clean fire-shovel; then add them to a pint of hot water, or rose-water. Stir them together, and let them stand some hours. Skim off the skin which will appear on the surface, and put the clear liquor into a clean bottle, to be well stopped.

Balls to take out Spots of Oil or Grease.

TAKE soft soap, and incorporate it with the ashes of burnt twigs and tendrils of the vine, equal parts: add a small portion of burnt alum and tartar in powder. Mix the whole, and form the mass into balls, with which spots may be removed from garments.

Cosmetic.

Cosmetic Lotion, resembling the celebrated Gowland's Lotion in its Effects, Smell, and Properties.

BLANCH two ounces of bitter almonds: beat them into a paste, taking care to add a few drops of distilled water during the pounding, that the mass may not turn oily: add to the paste, a pint of distilled water in which six grains of hydrargyrus muriatus have been dissolved, and shake them together. Apply the lotion, night and morning.

PART XII.

DYING SILK, WORSTED, COTTON, &c.

OF VARIOUS COLOURS.

THE art of dying, in the sense in which it is usually employed, is, the tinging of silk, worsted, cotton, and linen, with different colours, in the manner practised by those who do not meddle with any other branches, such as the staining of leather, &c.

On the theory of dying there are a variety of opinions, some of which are so contradictory to each other, and founded so much on speculation, as to bewilder rather than to enlighten. However, it is the professed object of this work to forego all attempts of the kind, and fine its pages to the detail of such manual operations as ve been hitherto successfully employed. No doubt a titude of matter might be added to the receipts here given, but the nature and extent of the undertaking will not allow of a complete treatise, which would alone occupy volumes, such as the literary world can furnish to those whose leisure and fortune enable them to enjoy and read them.

How to dye Silk, or Worsted, of a fine Carnation Colour.

First take, to one pound of silk, four handfuls of wheaten bran; put it into two pails of water; boil it; pour it into a tub, and let it stand all night; then take half the quantity of that water, and put into it half a pound of alum, a quarter of a pound of red tartar, beaten to a fine powder, and half an ounce of finely powdered turmeric. boil them together, and stir them well about with a stick; after they have boiled for a quarter of an hour, take the kettle off the fire; put in the silk, and cover the kettle close, to prevent the steam from flying out; leave it thus for three hours; then rinse your silk in cold water, beat wringing it on a wooden pin, and hang it up to dry.

Then take a quarter of a pound of gall-nuts; beat them fine, and put the powder into a pail of river-water; boil it, for one hour; then take off the kettle, and when you can bear your hand in it, put in your silk, and let it lay an hour; then take it out, and hang it up to dry. When the silk is dry, and you would dye it of a crimson colour, weigh, to each pound of silk, three quarters of an ounce of cochineal, beat to a fine powder, and sifted through a fine hair sieve; then put it in the pail with the remaining lye, and having mixed it well, pour it into a kettle; when it boils, cover it well, to prevent any dust coming to it. After you have put in three quarters of a pound, and two ounces and a half, of tartar, both finely powdered, let it boil for a quarter of an hour; then take it off the fire; let it cool a little, and put in the silk; stir it well with a stick to prevent its being clouded; and, when cool, wring it out. If the colour is not deep enough, hang the kettle again over the fire; and when it has boiled, and is grown lukewarm again, repeat the st[illegible]ng in of the silk; then hang it upon a wooden pin fastened in a post, and wring and beat it with a stick; after this, rinse the dyed silk in hot lye, wherein, to each pound of silk, dissolve half an ounce of Newcastle soap; afterwards rinse it in cold water. Hang the skeins of silk on a wooden pin, putting a little hand-stick to the bottom part, and thus having worked it, wring it and beat it round, you must hang it to dry.

Another Method to dye Silk of a Crimson Red.

TAKE of good Roman alum half an ounce, tartar one ounce, acid of vitriol a quarter of an ounce; put them, pulverized, into a pewter kettle, and pour as much water on them as is sufficient for half an ounce of the silk you purpose to dye; when it is ready to boil, put in the silk, which before you must boil in bran; boil it for an hour or more; then wring it out, and put to the liquor an ounce of cochineal, finely powdered, and sixty drops of acid of vitriol; when ready to boil, put in the silk again, and let it soak for four hours; then take clean water; drop into it a little acid of vitriol; rinse therein the silk; take it out again, and dry it on sticks, in the shade. This will be a high colour; but, if you would have it of a deep crimson, take, instead of acid of vitriol, spirit of sal-ammoniac to rinse your silk in.

General Observations in dying Crimson, Scarlet, or Purple.

1. YOUR boiler or kettle must be of good pewter, quite clean, and free from any soil or grease.

2. The prepared tartar must be put in when the water is luke-warm.

3. If you intend to dye woollen or worsted yarn, you may put it in the first boiling, and let it boil for two hours.

4. When boiled, take it out, rinse it, clean the kettle, and put in the water for the second boiling.

5. This second boiling is performed in the same manner as the first; then put in cochineal, finely powdered; when it boils, stir it well about.

6. Now the silk, which before has been washed and cleansed in the first lye, is to be put in, on a winch, which is continually turned about, in order to prevent the colours from fixing in clouds.

7. When the colour is to your mind, take it out; rinse it clean, and hang it up in a room, or a shady place, where it may be free from dust.

8. When the acid is put into the second boiling, it causes a coarse froth to swim at top, which you must carefully take off.

How to dissolve Pewter, for an Article called "Dyer's aqua-fortis."

TAKE fine pewter; put it into a glass vessel; a little clear water over it, and then pour on nitrous acid, which will dissolve it: the solution is of a whey, or milk colour: add more acid, till it is clear. The common proportion is, to one ounce of acid, a quarter of an ounce of pewter.

To dye a Crimson with Archil.

Put clean water into the kettle, and to each pound of silk take twelve ounces of archil; in this, turn your silk, and wring it out; then dissolve, to each pound of silk a quarter of a pound of alum, and as much white arsenic; in this liquor put the silk all night to soak; then wring it out; this done, take to each pound of silk, two ounces of cochineal, two ounces of galls, two ounces of gum, with a little turmeric: in this boil the silk for two hours; let it soak all night, and in the morning rinse it out.

To dye a Violet Colour.

First boil your silk in bran and alum, as has been shewn above; then clean your kettle; and, to clean water, put, to each pound of silk, one ounce of galls, one ounce and a half of cochineal, finely powdered, and one ounce of gum-arabic: boil it together, like the crimson red; leave it all night, and the next morning take out your silk, and rinse it in fair water.

To dye Worsted, Stuff, or Yarn of a Crimson Colour.

Take, to each pound of worsted, two ounces of alum, two ounces of white tartar, two ounces of nitrous acid, half an ounce of pewter, quarter of a pound of madder, and a quarter of a pound of logwood; put them together in fair water, boiling the worsted therein for a considerable time; then take it out, and when cool, rinse it in clean water: then boil it again, and put, to each pound of worsted, a quarter of a pound of logwood.

Another

Another Method.

TAKE, to eight pounds of worsted, six gallons of water, and eight handfuls of wheaten bran; let them stand all night to settle; in the morning, pour it clear off, and filter it; take thereof half the quantity, adding as much clear water to it; boil it up, and put into it one pound of alum, and half a pound of tartar; then put in the worsted, and let it boil for two hours, stirring it up and down, all the while it is boiling, with a stick. Then boil the other half part of your bran-water, mixing it with the same quantity of fair water as before; when it boils, put into it four ounces of cochineal, two ounces of finely powdered tartar; stir it well about, and when it has boiled for a little while, put in your stuffs: keep stirring it from one end of the kettle to the other with a stick, or turn it on a winch, till you see the colour is to your mind; then take it out of the kettle; let it cool; and rinse it in fair water.

Another, for Silk.

TAKE, to each pound of silk, a quarter of a pound of powdered Brasil-wood; boil it up, and strain it through a sieve into a tub, and pour water to it, till it is just luke-warm; in this, turn your silk, which before has been prepared as has been directed; and when all the strength is drawn out, rinse, wring, and dry it.

Another Incarnation.

TAKE, to each pound of silk, after it is rinsed and dried, four pounds of safflower; put the safflower in a bag, and wash it in clean water, till the water comes clear from it; then take the safflower out of the bag, press it between your hands, and rub it asunder in a clean tub; take to each pound of silk, four ounces of pot-ash; work it well together with the safflower; divide it into two parts; pour one part thereof into a close sack, that will keep the pot-ash from coming out, otherwise it will make the silk speckled; pour clear water over, to draw the strength out of the safflower; then take, to each pound of silk, a quarter of a pint of lemon juice; divide that also into two parts, and put each to the two quantities of safflower; hang your silk we[illegible] on clean sticks, and dip it in the first part of the liquor, continually, for an hour; then wring it well out, and hang it again on sticks: having prepared the other part of the safflower as you did the first, dip it therein, as before, for the space of an hour, then wring it well, and hang it up to dry in the shade, and you will have a fine colour.

A Carnation, for Woollen.

Take four ounces of ceruss, three ounces and a half of arsenic, one pound of burnt tartar, one pound of alum; boil your stuffs with these ingredients, for two hours; then take them out, and hang them up; the next morning, make a dye of two pounds of good madder, [illegible] ounces of turmeric, and three ounces of aqua-fortis.

To dye a Carnation, on Silk, or Cotton.

Take three pounds of alum, three ounces of arsenic, and four ounces of ceruss; boil your silk, or cotton, therein for an hour; then take it out, and rinse it in fair water; after which make a lye of eight pounds of madder, and two ounces of sal-ammoniac; soak the silk, or cotton, therein all night; then boil it a little in fair water, and put into it one ounce of pot-ash; then pour in some of the lye;

dye; and every time you pour, the colour will grow the deeper, so that you may bring it to what degree you please.

Another Method.

Take, to one pound of silk, cotton, or yarn, one ounce of tartar, and half an ounce of white starch; boil them together in fair water; then put in one quarter of an ounce of cochineal, a quarter of an ounce of starch, and a quarter of an ounce of pewter dissolved in an ounce of aqua-fortis, and mixed with fair water; when the water with the starch and tartar has boiled for some time, supply it with the cochineal and the above aqua-fortis; put in your silk, or whatever you have a mind to dye, and you will have it of a fine colour.

Another Method.

TAKE one ounce of tartar; starch and lemon juice, of each half an ounce; cream of tartar a quarter of an ounce; boil them together in fair water, adding a quarter of an ounce of turmeric: put in half an ounce of cochineal, and, a little while after, one ounce of aqua-fortis, in which you have dissolved a quarter of an ounce of pewter; then put in your silk.

dye Yarn, or Linen, of a lasting Violet Colour.

TAKE one pound of tartar, half a pound of alum, two ounces of Brasil-wood, and half an ounce of nitre; boil them together; then let them cool a little, and put in your yarn; let it soak for four hours, keeping the dye hot, but not boiling; after which, rinse and dry it.

How to prepare, or set, a blue Vat, for dying.

HEAT soft water in a kettle; fling four or five handfuls of wheaten bran, together with four pounds of pot-ash, into it; when that is dissolved, boil it for an hour, and add four pounds of madder, with this boil it for an hour longer; then pour the water into the vat, fill it not full, by the height of [illegible] and cover your vat; then set it, with indigo and woad, of each six pounds, and two pounds of pot-ash; put this into a small kettle in warm water, set it on a slow fire, and let it boil gently for half an hour, stirring it all the while; then pour that to the other liquors already in the vat.

To set a vat with indigo only, you must boil the first lye with pot-ash, four or five handfuls of bran, and half, or three quarters of a pound of madder; this boil a quarter of an hour, and, when settled, it will be fit for use. Then grind your indigo in a bowl, with an iron smooth ball, very fine, pouring or some of the lye, and mixing it together; when settled, pour the clear into the blue vat; and, on the sediment of the indigo, pour again some of the lye; this you should repeat, till you see the blue tincture is extracted clearly from it.

It is to be observed, that the madder must be but sparingly used, for it only alters the colour, and makes it of a violet blue, which, if you design to have, cochineal is the fitter for. The mixed colours in blue are the following: dark blue, deep blue, high blue, sky blue, pale blue, dead blue, and whitish blue.

By mixing of blue and crimson is produced purple, columbine, amaranth, and violet colours; also from those mixtures may be drawn the pearl, silver, gridelin, &c. colours.

From a middling blue and crimson are produced the following colours, viz. the pansy, brown grey, and deep brown.

Care must be taken that in setting the blue vat, you do not overboil the lye, by which the colour becomes muddy and changeable; be also sparing with the pot-ash, for too much gives the blue a greenish and false hue; but experience is the best instructor in this.

Another Direction how to set a Blue Vat; together with several Observations in the Management, both for Silk and Worsted.

TAKE half a bushel of clean beech-ashes, well sifted: of this make a lye with three pails of river or rain-water; pour it into a tub, and put in two handfuls of wheaten bran, two ounces of madder, two ounces of white tartar, finely powdered, one pound of pot-ash, half a pound of indigo, pounded; stir it all well together, once every twelve hours, for fourteen days successively, till the liquid appears green on your fingers, and it is fit for dying; however, when ready, stir it every morning, and when you have done, cover it.

When you are going to dye silk, first wash the silk in a fresh warm lye; wring it out, and dip it into the vat. You may dye it of what shade you please, by holding it longer or shorter in the dye.

When the colour is to your mind, wring the silk; and having another tub ready at hand, with a clear lye, rinse your silk; then wash and beat it in fair water, and hang it up to dry.

When the vat is wasted, fill it with the lye; but if it grows too weak, supply it with half a pound of pot-ash, half a pound of madder, one handful of wheat-bran, and half an handful of white tartar; let it stand for eight days, stirring it every twelve hours, and it will be again fit for use.

Another Method, for Woollen.

FILL a kettle with water: boil it up, and put pot-ash into it; after it has boiled with that a little, put in two or three handfuls of bran; let it boil for a quarter of an hour, and then cover it; take it off the fire, and let it settle.

Pound indigo as fine as flour; then pour the above lye to it; stir, and let it settle, and pour the clear lye into the vat; then pour more lye to the sediment, stir it, and when settled, pour that into the vat also; repeat this till the indigo is wasted. *Or,*

Take to a quarter of a pound of indigo half a pound of pot-ash, a quarter of a pound of madder, three handfuls of borax; let them boil for half an hour, and then settle; with this lye grind your indigo in a copper bowl; put this in an old vat of indigo, or on a new one of woad, and it will make it fit for use in twenty-four hours.

To dye Silk of a Straw Yellow.

TAKE alum and rinse your silk well, as has been directed before; then take and boil, to each pound of silk, one pound of fustic, and let them stand for a quarter of an hour; then put into a tub large enough for the quantity of the silk, a sufficient quantity of that lye, and fair water; in this rinse the silk; fill the kettle again with water, and let it boil for half an hour, and having wrung the silk out of the first liquor, and hung it on sticks, prepare a stronger lye than the first, in this dip your silk, till the colour is to your mind.

Another Method.

PUT into a clean kettle, to each pound of silk, two pounds of fustic, let it boil for an hour; then put in six ounces of gall; let them boil together half an hour longer. The silk, being alumed and rinsed, is turned about in this colour; then take it out of the kettle, and wring it; dip it in pot-ash lye, and wring it out again; then put it into the kettle; let it soak a whole night, and in the morning, rinse, beat it out, and hang it up to dry.

Of dying Silk, &c. of different Green Colours.

THE middling colour of blue and yellow produces a light green, grass-green, laurel-green, sea-green, &c.

All olive colours, from the deepest to the lightest, are nothing else but green colours, which by walnut-tree root, fustic, or soot of chimneys, are changed to what shade you please.

A fine Green for Dying Silk.

TAKE, to one pound of silk, a quarter of a pound of alum, and two ounces of white tartar; put them together in hot water to dissolve; then put in your silk, and let it soak all night; take it out the next morning, and hang it up to dry; then take one pound of fustic, and boil it in four gallons of water, for an hour; take out the fustic, fling it away, and put into the kettle half an ounce of fine beaten verdigrise; stir it about for a quarter of an hour, draw it off into a tub, and let it cool; then put into that colour an ounce of pot-ash; stir it together with a stick; dip into it your silk, till you think it yellow enough; then rinse it in fair water, and hang it up to dry; then dip it in the blue vat, till you think it enough; rinse it again, and beat it over the pin, and hang it up to dry; thus you may change the shades of your green, by dipping either more or less, in the blue or yellow.

For the green, take, to one pound of silk, three ounces of verdigrise, beaten to a fine powder; infuse it in a pint of wine vinegar for [illegible] night; then put it on the fire; when hot, stir it with a stick, and keep it from boiling; in this put your silk, two or three hours, or, if you would have it of a light colour, let it soak but for half an hour; then take scalding hot water and in a trough, with Newcastle soap, beat and work up a clear lather; in this rinse your silk; then hang it up to dry; rinse it again in river-water; beat it well; and when it is well clean, and

How to dye Linen of a Green Colour.

Soak your linen over night, in strong alum water; then take it out and dry it: take woad, boil it for an hour; take out the woad, and put in one ounce of powdered verdigrise, according to the quantity you have to dye, more or less; stir it, together with the linen briskly about; then put in a piece of pot-ash, the bigness of an hen's-egg, and you will have your linen of a yellow colour, which, when dried a little, and put into a blue vat, will turn green.

To dye Yarn of a Yellow Colour.

In a kettle of strong lye, put a bundle of woad, and let it boil; then pour off the lye and take, to one pound and a half of yarn, half an ounce of verdigrise, and half an ounce of alum; put it into a quart of brown Brasil-wood liquor, boiled with lye; stir it well together and pour it in, and mix it with the woad-lye, in this soak your yarn over night, and it will be of a good yellow.

To

To dye Green Yarn, or Linen, Black.

TAKE a sharp lye; put in three pounds of brown Brasil, and let it boil for some time; then pour off the colour from the chips, into a tub; add to it one ounce of gum arabic, one ounce of alum, one ounce of verdigrise; in this lay your yarn, or linen, to soak over night, and it will be of a good black.

To dye Silk an Orange Colour.

AFTER you have cleaned your kettle well, fill it with clean rain water, and take, to each pound of silk, four ounces of pot-ash, and four ounces of Orleans-yellow; sift it through a sieve into the kettle; when it is well melted, and you have taken care not to let any of the ingredients stick about the kettle, put in your silk, which before you have prepared and alumed as has been directed; turn it round on the winch, and let it boil up; then take and wring it out; beat it, and rinse it; then prepare another kettle, and take, to each pound of silk, twelve ounces of gall-nuts; let the gall-nuts boil for two hours; then cool for the same space of time; after which put in the silk, for three or four hours; then wring it out; rinse, beat, and dry it.

Another Orange Colour.

SOAK the white silk in alum water, as you do in dying of yellow: then take two ounces of Orleans-yellow, put it over night in water, together with one ounce of pot-ash: boil it up; add to it, after it has boiled half an hour, one ounce of powdered turmeric; stir it with a stick, and, after a little while, put your alumed silk into it, for two or three hours, according to what height you would have your colour; then rinse it out in soap-suds, till it looks clear, afterwards clear it in fair water, and dress it according to art.

A fine Brimstone Yellow for Worsted.

TAKE three pounds of alum, one pound of tartar, and three ounces of salt; boil the cloth with these materials for one hour; then pour off that water, and pour fresh into the kettle; make a lye of shart and potash; let it boil well; then turn the cloth twice or thrice quickly, upon the winch, and it will have a fine brimstone colour.

A Lemon Colour.

TAKE three pounds of alum, three ounces of ceruss, and three ounces of arsenic; with these ingredients boil the cloth for an hour and a half; then pour off that water, and make a lye of sixteen pounds of yellow flowers, three ounces of turmeric; then draw, or winch, your cloth through, quickly, and you will have it of a fine lemon-colour.

To aye an Olive Colour.

To dye this colour, observe the first directions for dying a brimstone colour; then make a lye of gall-nuts and vitriol, but not too strong; draw your stuff quickly through, three or four times, according as you would have it, either deeper or lighter.

To dye a Gold Colour.

HAVING first dyed your silk, worsted, cotton or linen of a yellow colour, take, to each pound of the commodity, one ounce of yellow chips, and of pot-ash the quantity of a bean; boil for half an hour; then put in your silk, and turn it till the colour is to your liking.

The Dutch *Manner of dying Scarlet.*

Boil the cloth in water with alum, tartar, rock-salt, aqua-fortis, and pea-flowers, in a pewter kettle; then put into the same kettle, starch, tartar, and cochineal, finely powdered, stirring or turning the cloth well about; thus you may, by adding more or less cochineal, raise the colour to what height you please.

General Observations for dying Cloth of a Red or Scarlet Colour.

1. The cloth must be well soaked in a lye made of alum and tartar; this is commonly done with two parts of alum, and one part of tartar.

2. For strengthening the red colour, prepare a water of bran, or starch: bran water is thus prepared, take five or six quarts of wheaten bran; boil it over a slow fire in rain-water for a quarter of an hour, and then put it, with some cold water, into a small vessel, mixing it up with a handful of leaven (the sourer it is made, the better it is); this causes the water to be soft, and the cloth to become mellow: it is commonly used in the first boiling, and mixed with the alum-water.

3. *Agaric*, is an ingredient used in dying of reds, but few dyers can give any reason for its virtue: as it is of a dry and spongy nature, it may reasonably be supposed, that it contracts the greasiness which may happen to be in the dye.

4. The use of arsenic is a very dangerous ingredient; [illegible], or marine acid may supply its place as well.

5. Scarlet is nothing else than a sort of crimson colour: the aqua-fortis is the chief ingredient in the change; this may be tried in a wine glass, wherein a deep crimson colour is put; by adding drops of aqua-fortis to it, it will be changed into a scarlet.

6. Observe that you always take one part of tartar to two parts of alum; most dyers prefer the white to the red tartar; but, however, in crimson colours, and others that turn upon the brown, the red tartar is chose by many as preferable to the white.

To prepare the Cloth for dying of Scarlet.

First take, to one pound of cloth, one part of bran-water, and two parts of river water; then put into it two ounces of alum, and one ounce of tartar; when it boils and froths, scum it, and put in the cloth; turn it therein for an hour, and take it out and rinse it.

To dye Cloth of a common Red.

Take, to twenty yards of cloth, three pounds of alum, one pound and a half of tartar, and one-third of a pound of chalk; put them in a kettle with water, and boil them: then take six pounds of good madder, and a wine-glassful of vinegar; let them be warmed together; put in the cloth, and turn it round upon the winch, till you observe it red enough; then rinse it out, and it will be of a fine red.

Another Method.

Take four pounds of alum, two pounds of tartar, four ounces of white lead, and half a bushel of wheat bran; put these ingredients, together with the cloth, into a kettle; let it boil for an hour and half, and leave it [illegible] all

nigh.

night; then rinse it, and take, for the dye, one pound of good madder, two ounces of Orleans'-yellow, one ounce and a half of turmeric, and two ounces of aqua-fortis; boil them; turn the cloth, with a winch, for three quarters of an hour, and it will be of a good red.

To dye a Brown Colour.

BROWN colours are produced by the root, bark, and leaves of walnut-trees, and also by walnut-shells; china-root might also be used for brown colours, but it being of a disagreeable scent, it should only be used for hair colours in stuffs, for which, and the olive colours, it is of more use: the best browns are dyed with woad and walnut-tree root.

A Nutmeg Colour, on Stuffs.

TAKE three pounds of alum, and half a pound of tartar; put this into a kettle of water, and boil your stuff for an hour and a half, and take it out to cool. Then take one pound and a half of fiset-wood, or yellow flowers, three pounds of madder, one pound of gall-nuts; put them, together with the stuff, into a kettle; boil and turn it with a winch, till it is well enough, and take it out to cool; then take two pounds of vitriol, which before is dissolved in warm water, put it in the kettle, and turn the stuff till the colour is to your mind; then rinse it out.

Or,

Take half a bushel of [illegible] walnut-shells, or walnut-tree-leaves, to a kettle of water; and when it begins to boil, put in the stuff, over a winch; turn it about three or four times; then take it out, [illegible] cool; after it is cold, boil the liquor again, and put the stuff in; turn it for half an hour, and take it out and let it cool; then put one pound of gall-nuts, three pounds of madder, together with the stuffs, into the kettle; let it boil for an hour;

take it out and let it cool again; take one pound of vitriol, put it in, stir it well about, then put in again the stuffs, over the winch; turn and boil it till you perceive your colour deep enough; then take it out, and rinse it.

How to make Flax Soft and Mellow.

MAKE a strong lye of wood or pot-ashes, and unslacked lime, in which soak your flax for twenty-four hours; then put it, together with the lye, into a copper, and let it boil, and it will be as soft as silk. After this, rinse it in clean water, wring out the water, and put the flax again into a strong lye; repeat this thrice; then rinse it out, dry it, and it will answer your purpose. Some prefer cow-dung, with which the flax is daubed all over; or soak it in a lye of cow-dung, for twenty-four hours, then rinse and dry it.

An excellent Water for taking out Spots in Cloth, Stuff, &c.

TAKE two pounds of spring water, put in it a little potash (about the quantity of a walnut) and a lemon cut in small slices; mix this well together, and let it stand for twenty-four hours in the sun; then strain it through a cloth, and put the clear liquid up for use; this water takes out all spots, whether pitch, grease, or oil, as well in hats, as cloth, stuffs, silk, cotton, and linen, immediately. As soon as the spot is taken off, wash the place with water; and, when dry, you will see nothing.

To dye Woollen Stuffs of a Black Colour.

FINE cloths, and such stuffs as will bear the price, must be first dyed of a deep blue, in a fresh vat of pure indigo; after which, boil the stuffs in alum and tartar, then dye in madder; and lastly with galls of Aleppo, vitriol, and Sumach.

Sumach, dye it black. To prevent the colour soiling when the cloths are made up, they must, before they are sent to the dye-house, be well scowered in a scowering mill.

Middling stuffs, after they have been prepared by scowering and drawn through a blue vat, are dyed black with gall-nuts and vitriol.

For ordinary wool, or woollen stuffs, take of walnut-tree branches and shells, a sufficient quantity; with this boil your stuff to a brown colour; then draw it through the black dye, made with the bark of elder, iron, or copper filings, and Indian-wood.

To dye Linen of a Black Colour.

Take filings of iron, wash them, and add to them the bark of elder-tree; boil them up together, and dip your linen therein.

To dye Woollen of a good Black.

1. Take two pounds of gall-nuts, two pounds of the bark of elder-tree, one pound and a half of yellow chips, boil them for three hours; then put in your stuff, turn it well with the winch, and when you perceive it black enough, take it out and cool it.

2. Take one ounce and a half of sal-ammoniac, with this boil your stuff gently for an hour long, turning it all the while with the winch; then take it out again and let it cool.

3. Take two pounds and a half of vitriol, a quarter of a pound of Sumach; boil your stuff therein for an hour; then cool and rinse it, and it will be of a good black.

Another Black Colour for Woollen.

For the first boiling take two pounds of gall-nuts, half a pound a pound of Brasil-wood, two pounds and a half of madder; boil your cloth with these ingredients for three hours, then take it out to cool; for the second boiling, take one ounce and a half of sal-ammoniac, and, for the third, two ounces and a half of vitriol, three quarters of a pound of Brasil, and a quarter of a pound of tallow.

Another Black Colour, for Plush.

Put the following ingredients into a large vessel, viz. eight pounds of elder bark, eight pounds of Sumach, twelve pounds of oaken chips, nine pounds of vitriol, two pounds of wild marjoram, six pounds of tile-dust, some waste of a grind-stone, six pounds of walnut-leaves, half a pound of burnt tartar, two pounds of salt, four pounds of woad, on these pour boiling water till your vessel is full: your plush, after it is well boiled and cleansed, must be well galled, by boiling it in one pound and a half of Sumach, eight ounces of madder, two ounces and a half of burnt nitre, half an ounce of sal-ammoniac, one ounce and a half of vitriol, half an ounce of burnt tartar; then take it out, and let it dry, without rinsing it.

Then fill the kettle with the above liquor, and boil and dye your plush in the manner as you do other stuffs, turning it round with the windle; when the colour is to your mind, take out the plush, let it cool, and rinse and hang it up to dry.

To dye Silk of a good Black.

In a kettle containing six pails of water, put two pounds of beaten gall-nuts, four pounds of Sumach, a quarter of a pound of madder, half a pound of antimony finely powdered, four ox-galls, four ounces of gum tragacanth dissolved in fair water, fine beaten elder-bark two ounces, and one ounce and a half of iron file-dust; put these in-

gredients